Edw. Wright 1610 Arch. Salom.

Certaine ERRORS IN NAVIGATION, Detected and Corrected By Edw: Wright

With

Many additions that were not in the former edition as appeareth in the next pages.

Printed by Felix Kyngston at London. 1610.

Additions to this edition that were *not in the former.*

1 THe table for the true diuiding of a meridian of the Sea-chart, heere called the table of Latitudes, made to euery minute of the quadrant, which in the former edition was to euery tenth minute, from page 21 to the 112.

2 Diuers additions concerning the true graduating and making both of a general and particular Sea-chart, and touching the vſe of the table of Latitudes, in the 4, 5, 6, and 7 Chapter.

3 The angle of any Rumbe or Heliſphærical line with the æquinoctiall being giuen, to finde preſently the latitude thereof for any longitude giuen, pag. 128.

4 The table of Rumbes more exactly calculated then before, and a table of the eighth rumbe calculated to euery tenth minute and added to the former: from pag. 153, to 161.

5 The vſe and making of the Sea-rings, from pag. 199, to the 206.

6 A table of the magnetical inclination calculated to euery degree of the quadrant, together with the geometrical demonſtration of the making thereof.

7 To finde the angle of the true horizontal line, with the viſuall line touching the roundnes of the ſea at any height of the eye aboue the water, and to this end an obſeruation and demonſtration for the finding of the quantitie of the earths ſemidiameter: from pag 217, to 229.

8 A table of Refractions of the Sunne and fixed ſtarres, pag. 232.

9 The table of declination of euery minute of the ecliptick,

ecliptick, newly and exactly calculated in degr. min. and ſeconds, to the greateſt obliquitie of 23 degrees, 31 min. 30 ſeconds, from pag. 237, to 297.

10 The table of Obſeruations of the Sunne, corrected by his parallax, from pag. 310, to 329.

11 The eccentricitie of the Sun, the place of his apogæum, and tables of his middle motions, found out and corrected according to the ſaid obſeruations in Chap. 20, 21.

12 A new Theorick of the Sun, and the manner of making the table of the Sunnes proſthaphæreſes thereby, from pag. 349, to 355.

13 New Ephemerides of the Sun for fiue yeeres, and how to make them and continue them for many yeeres paſt or to come, from pag. 356 to 386.

14 A new table of the Sunnes declination for the mariners vſe, and how by certain proſthaphæreſes to continue the ſame for many yeers, frō pag. 390 to 422.

15 The errors of *Simon Steuin* in finding fault with my table of Rumbs, from the 452 pag. to the 472.

16 A ſhort treatiſe of ȳ whole Art of Nauigation.

17 A new and exact table of the Suns declination made, and to be vſed according to the ordinarie manner wherewith Engliſh mariners haue been moſt acquainted: from pag. 99 to 112.

18 A moſt eaſie and exact way to finde the true height of the pole in any north latitude by knowledge of the height of the pole-ſtarre, when the guard is in any of thoſe 8 ordinarie poſitions, commonly noted amongſt Seamen: from pag. 113 to 122.

19 A table of obſeruations of the variation of the Compaſſe, taken in all parts of the world almoſt whither any nauigation hath been made in our age.

FINIS.

Certaine ERRORS IN NAVIGATION, Detected and Corrected By Edw: Wright

With Many additions that were not in the former edition as appeareth in the next pages.

Printed by Felix Kingston at London 1610.

TO THE HIGH AND MIGHTIE PRINCE HENRY, Prince of *VVales*, Duke of *Cornwall*, Earle of *Cheſter*, &c. and eldeſt Son to our ſoueraigne Lord IAMES, King of great *Britaine*, *France* and *Ireland*.

AS your Highneſſe honourable accoũt of the Art of Nauigation, hath latelie appeared to the world, in building ſuch a goodly & princely Royall Ship, as in the opinion of men of skill in that kinde, may iuſtly be compared with the beſt that floateth on the ſeas in theſe daies: So hauing hitherto ſpent the beſt of my time in ſuch ſtudies as containe the firſt and principall

grounds of that moſt admirable Art, and finding many notorious errors, as well in the books of the chiefeſt authors that haue written thereof, as alſo in the daily practiſe of our beſt Nauigators, following (for want of better) the rules preſcribed by thoſe authors, I thought my ſelfe bound in dutie, eſpecially ſince the beginning of the building of that Ship, to beſtow my beſt endeuour in correcting thoſe errors and perfecting ſo excellent an Art ſo much as I could; that as both the skill of our chiefeſt builders of ſhips in directing, as alſo the induſtrie of the inferiour workmen the Shipwrights, in executing their direction in building ſhips of all faſhions, for all purpoſes on land, ſeemeth in our time to be growne almoſt to the higheſt pitch of perfection; ſo both our Maſters and mariners at ſea, though alreadie they haue ſhewed and approued themſelues comparable with the beſt of any other nation, may in their kinde alſo bee found nothing inferiour to the other, in the well gouerning and ſafe and ſpeedie carying of thoſe ſhips to all parts of the world, whither they may haue occaſion

occasion to goe, if hereafter it shall fall out to be either your Highnesse pleasure, or the desire of any other honorable and worthie Patriots for the glorie of God, the honor of their natiue countrie, and their own immortall fame, to set them foorth, for the discouerie of strange and forraine lands and nations yet vnknowne, whereby the poore people there liuing in darknesse and in the shadow of death, hauing hitherto been bred and brought vp in most wofull and horrible idolatries and superstitions, deuoting themselues, and in diuers places sacrificing one another to Diuels, in stead of worshipping the euerliuing God, may in short time grow to some acquaintance and familiaritie with this our Christian world, & in the end come to the sauing knowledge of the true God, and of their and our blessed Sauiour and Redeemer: which most worthie worke of God, will assuredly before his presence at the last day, bring much more profit, comfort, yea and honor also to the authors and effecters thereof, then all the victories and conquests of great *Alexander* and *Cæsar* and all

the reſt of the mightieſt Monarchs that euer liued in this world. And ſurely, moſt worthy and noble Prince, in whoſe yonger yeeres many excellent vertues and graces of God doe euidently ſhew themſelues, euen God himſelfe alſo the great ruler of this world, in his diuine prouidence and adminiſtration thereof, apparantly ſeemeth to aime at this marke: for elſe what ſhould it meane that within theſe few ſcores of yeeres (in a manner) hee hath diſcouered to the world the greateſt and rareſt ſecrets of the Art of Nauigation, farre exceeding all that could bee found out by the wit and induſtrie of man in diuers thouſands of yeeres before, firſt in reuealing that moſt excellent and wonderfull propertie of the Loadſtone, and needle touched therewith, in pointing North and South; whereby in the cloſeſt weather and darkeſt nights the mariner, who otherwiſe ſhould bee will (as they ſay) and at his wits end, not knowing which way to winde or turne himſelf, might notwithſtanding know (as it were by a meſſenger ſent from heauen) what wind bloweth, and towards what

part

part of the world his shippe goeth at all times.

Secondly, in manifesting vnto vs the declining qualitie of the same needle, whereby in most places of the world it declineth or varieth from the true points of North and South towards the East or West, which is therefore called the variation, or northeasting and northwesting of the Compasse, or Magneticall needle. Which at the first discouerie of the needles north-pointing was not marked; afterward it was doubted of by some, and by others (as namely by *Peter of Medina*) vtterly denied, and with many arguments opposed and disputed against, as a great imperfection and absurditie, most vnworthie the dignitie and excellencie of a stone so pretious as the Loadstone is, and therefore by him ascribed, only to the rude and grosse obseruations of mariners: and by others to the vnskilfull touching of the needle, not with the true north and south points of the stone, but with some other parts thereof. Yet now in our time by manifold and exact obseruations both of our

owne countrie men, and diuers others in all parts of the world almost, whither any Nauigation hath been made; this variation is manifestly prooued, and found not only no disgrace or imperfection, but a singular increase and augmentation of price and excellencie to that (otherwise most pretious) stone; in that not only by meanes of the first discouered north-pointing propertie thereof, it directeth vs towards what part of the world, or vpon what point of the Compasse we should guide our selues at sea: but further also by this varying or declining of the needle in some places of the world eastward, in some westward, in some places much, in some other little, and in some nothing at all: and yet alwaies certaine, and the same at the same place: by this variation, I say, and this varietie thereof, the industrious obseruing seaman, when hee hath diligently obserued the same in any place at sea, together with the latitude of the same place, keeping a note of those obseruations, doth by the like obseruations at any other time when he shall haue occasion to trauell that way, easily know,

when

when hee commeth at, or neere the ſame place againe, and ſo by this variation performeth almoſt ſo much in effect as the inuention of the longitude.

To theſe adde the third rare and admirable propertie of the inclination, lately found in the Magneticall needle; whereby (ſo ſoone as it hath been touched with the ſtone) the north end thereof in all this our northerne hemiſphære immediatly falleth a certaine number of degrees vnder the Horizon, and in all the other Southerne halfe of the earth beyond the Line, it riſeth as much aboue the ſame. Which ſtrange propertie, firſt by chance found out but a fewe yeeres ſince by the ingenious Artificer our countriman *Robert Norman*, and then much more diſcouered by Doctor *Gilbert* and that Reuerend Diuine your H. Chaplaine M^r. *William Barlowe*, induſtrious & happie ſearchers and finders out of many rare magneticall ſecrets; and laſtly approoued and confirmed, by the obſeruation and experience of diuers our beſt Nauigators at ſea, in their longeſt voyages both North and South.

South: this inclination, I say, of the magneticall needle, if it be well and artificially handled, and obserued with meete and conuenient instruments for such a purpose, affoordeth in a manner the like hope of finding as much in effect as the latitude, as the variation doth of the longitude, and that also in the closest weather and darkest nights that can happen.

But now leauing this little magneticall earth a while, let vs in our thoughts ascend to heauen, and there consider of those diuine helpes which God from thence affoordeth vs for Nauigation, in the beholding and obseruing of those glorious celestiall bodies, the Sunne, I say, the Moone and Starres, the only sure and euident markes the mariner hath at sea, whereby hee may safely and certainly rectifie his course when he hath for many weekes (and moneths also sometimes) sailed vpon the vast Ocean without sight of any land at all, nothing else being to be seene all that while, but *Cælum vndique, & vndique pontus:* let vs now, I say, (when all land marks haue been lost and out of sight for a long time)

time) conſider of thoſe faire markes cleerly ſhining in the heauens, and from thence appearing vnto the ſight & view of the whole world: It is aſſuredly very much worth the noting, that euen in this our time alſo, thoſe heauenly bodies haue been much more diligentlie and exactlie obſerued, and their places and all their motions much more truly found out, then euer they were before in all preceding ages; whereby the table of the declination of the Sunne and fixed ſtarres, which haue in former times been very faultie, erring not only a great many of minutes but in whole degrees alſo, ſome of them, and thoſe alſo euen of the principall, and by mariners moſt obſerued fixed ſtarres; thoſe tables, I ſay, of declination both of the Sunne and fixed ſtarres are now brought to that perfection, euen in this booke here following, that ſcarſe one minute of error can bee found in them, which at ſea is a matter of very ſmall moment, and by the mariner not poſſible to bee there obſerued. Notwithſtanding ſuch kinde of inſtruments, and maner of obſeruation are lately growne in vſe

amongſt

amongst some of them, as I perswade my self can hardly be amended. Which also maketh not a little to the proofe of my purpose now in hand, considering that not only these, but all sorts of instruments needfull for Nauigation are now in growing, and very shortly like to come to farre greater perfection then hitherto they euer had. Amongst which instruments the Sea-chart and Compasse may worthily be accounted the chiefest. The first of which is in this booke also so corrected and reformed, that all the faults found therein by *Petrus Nonius* in his booke *de Reg. instrument. & obseruationibus Geometr.* and by *Martin Cortese*, (in his booke of the Art of Nauigation to *Charles* the 5, Emperor) or any other * are cleerely auoided; and the whole chart generally so amended, that it sheweth all things needfull for the vse of Nauigation as truly as the Globe it self can doe. Neither will the Compasse tarrie long behind the rest in recouering his perfection also, which alreadie beginneth to be freed from that rude and grosse manner of handling, which in the making thereof was generally

* *Sir Humfrey Gilbert. Mr. William Burrough. Mr. Rob. Hues.*

rally wont to be vſed. So that wee may vniuerſally and truly conclude, that euen in our time the whole Art of Nauigation is growne to much greater perfection, then by the relation of any ancient or moderne hiſtories or writers, it can appeare that euer it had in any former ages.

Neither doth this perfection we ſpeak of, ſhew it ſelfe in the Art only, but in many of the artſmen themſelues alſo (I meane the mariners and ſeamen) that daily practiſe and exerciſe that Art: the rules and grounds whereof they find by their often experience ſo certaine and infallible, that with aſſured confidence next vnder God, reſting themſelues vpon the certaintie of their Art; they are within theſe few yeeres growne to ſuch courage and reſolution, that being ſet forth by our worthy prouident and reſolute Merchants, they ſeeme to make no more account of ſailing to the vtmoſt *VVeſt* and *Eaſt Indies*, yea euen as farre as *Japan* and *China*, then in times paſt many would haue done to croſſe ouer the ſea, to our next neighbours. Nay euen the very compaſſing and ſailing round

round about the whole Globe of this our inferiour world, (as twice hath been done in our time by thoſe worthie famous Gentlemen Sir *Francis Drake*, and Mr. *Thomas Candiſh*, the firſt leaders that euer accompliſhed ſo ſtrange and dangerous an enterpriſe in their owne perſons) the compaſſing, I ſay, of this whole earth ſeemeth now adaies to many of our mariners no great matter; who ſo ordinarily paſſe ouer the greateſt ſeas of the world euery way, as if there were continuall bridges to all coaſts built ouer the ſame: nay rather indeed with much more conuenience, ſafetie, and facilitie, then if the whole Ocean were euery where vaulted or arched ouer from one ſhore to another.

The effects and fruites of this their skill, courage and reſolution, haue very apparantly and plentifully ſhewed themſelues euen within this ſhort time of your H. continuance within this Realme of *England*, in which time there hath bin as much or more found out by our nation both by ſea and land, then in as many yeeres before hath bin; aſwell in ſearching the *Northeaſt* and *Northweſt paſ-*

ſages,

ſages, as alſo in diſcouering the ſeacoaſts and inland of *Virginea*, *Newfoundland*, *Groenland*, and the north *Newland*, as farre as *Hackluyts headland*, within 9 degrees of the Pole: alſo of *Guiana*, and diuers parts and Ilands of the *Eaſt Indies*; yea and ſome parts alſo of the South continent, diſcouered by the worthie Knight Sir *Richard Hawkins*, a little before his entrance into the Straits of *Magellan*, and his voyage into the *South Sea*, which himſelf hath diligently ſet downe ſince his returne out of his long Spaniſh Captiuitie into *England*, which was but the winter before your Highneſſe happie comming into this Kingdome. And good hope there is, that this perfection which we haue ſpoken of, both of the Art of Nauigation, and of the Artſmen the Nauigators alſo, will not long reſt or remaine at ſtay, as now they are, but bee ſtill proceeding and daily growing on to more perfection euerie way. Some comfortable ground whereof hath not long ſince appeared in the Worſhipfull Societie of the *Trinitie houſe*, who haue been ſo greatly encouraged by the ſingular fauour of his Maieſtie,

in renewing their priuileges and corporation, that of late, especially by the discreete & careful gouernment of Mr. *Hugh Merrick*, (their Master at this time) they haue reformed many grosse and dangerous enormities; and cease not there, but intend also to found the long wished for Lecture of the Art of Nauigation, and a Graund Pilot, as *Sebastian Cabot* was, first in *Spaine*, and afterward confirmed here in *England*, with an honorable pension of 166 pound, 13 shillings and foure pence, to him granted by King *Edward* the 6; as is to be seene in the office of the Rolles, and in the third volume of Mr. *Hacklayts* voyages, pag. 10. Both which [*Lecture and Pilot*] how necessarie and profitable they will be in this State and time especially, wherein we now liue, (our Merchants and Mariners daily vndertaking and putting in vre the longest Nauigations in the world) may euidently appeare by the experience of many yeeres in the Contractation house of *Seuil* in *Spaine*, where the renowned Emperour *Charles* the fifth considering the manifold losses and wracks, which through

the

the ignorance and vnskilfulnes of his ſea-men, both himſelfe and his people ſuſtained in ſailing to and from the *VVeſt Indies*; for redreſſe hereof appointed a Pilot maior to examine ſuch as ſought to take charge of ſhips, and alſo founded a Lecture of Nauigation, which euer ſince his time hath been there continued, as it may appeare by the bookes which the Readers of that Lecture haue ſet foorth with the King of *Spaine* his priuilege. And how acceptable ſuch a Lecture will be to our ſea-men and mariners, it hath alreadie appeared in many of them, who although they had nothing elſe wherewith to ſuſtaine themſelues, but what they got by baniſhing themſelues (as it were) from their neereſt friends and natiue countrie, to remaine in a wooden priſon, alwaies within one ſpanne of preſent death, with the dangerous aduenture of their deareſt liues alſo at ſea many times; haue yet been content to impart ſome good portion thereof for their better inſtruction, in ſuch points whereof they were ignorant.

To the furtherance therefore of ſo neceſ-

ſarie

sarie, profitable and charitable a worke, as the founding of this Lecture will be, if your H. shall vouchsafe to giue countenance and incouragement, it will no doubt after many attempts be now brought to very good effect, to the great benefit of thousands of our Merchants and mariners, whom you shall hereby deeply binde to be thankfull to God and your H. for your princely care of their common good; and my selfe also for this and many other tokens of your gratious fauour towards me, of late especiallie when I least expected, to be a continuall suitour to the Almightie for the increase and continuance of all his blessings to you both temporall and eternall.

Your Highnesse most humbly

deuoted Seruant,

Ed. Wright.

THE PREFACE TO THE READER.

THE Art of Nauigation (as it is called) though it hath now been in vſe ſome thouſands of yeeres, yet how farre it is at this day from the perfection which is and were to be deſired, wee would ſcarce beleeue (as a wonder that a thing of ſo great commoditie, ſhould no more be ſought into, in ſo many ages:) but that both the bookes of the learned are extant, to teſtifie, and reaſon (approued by often triall) doth plainly ſhew that the principal meanes, and Inſtruments this Art vſeth, haue been thus long ſo farre from this perfection, that contrariwiſe they haue been and are much ſtained with many blots and blemiſhes of error and imperfection.

1 The Sea-chart (the beſt meane the mariner hath to know the courſe from place to place) as it hath bin hitherto generally made, is ſo faultie in the very foundation and ground-work thereof (that is, in the geometricall lineaments of the meridians, parallels, and rumbs deſcribed therein) that hereof there may ariſe ſo groſſe error, as may cauſe the mariner to miſſe one, two, yea three whole points of the Compaſſe (and more ſometimes in a farre Northerly or Southerly nauigation) in finding the courſe from

place to place. Whereof it may alſo be neceſſarily inferred, that following the direction of his Chart, in ſuch ſort as hath been uſed for finding the diſtances of places, he may erre twice, yea thrice ſo much as the whole diſtance commeth to, and more ſometimes in thoſe Northerne parts, in taking the diſtance to bee twice, thrice, yea foure times greater then indeed it is.

2 The Compaſſe, the chiefeſt Inſtrument for keeping the courſe, ſhewed by the Chart, by the variation neglected (as by ſome it hath been) may cauſe you erre an whole point or two in the courſes of diuers places: and not rightly vſed, hath bred much confuſion in many parts of the Chart, in laying out many places in falſe courſes: which muſt needs follow when the Chart is made according to the direction ſhewed by the points of the Compaſſe, without abatement or allowance anſwerable to the variation in euery place. This may eſpecially be ſeene in thoſe places where the variation is greateſt; as vpon the coaſt of *Florida*, *Noua Francia*, and Newfound land: where ſome alſo ſeeking to auoid this inconuenience, haue fallen into another as ill or worſe then the former, in making a double ſcale of latitude. And thus one error as a fruitfull mother breeding another, and one abſurditie admitted drawing many with it: it will manifeſtly appeare by exact diſcourſe out of theſe grounds (that partly through the falſe proiection of the Chart, & partly through neglecting, or not rightly vſing the variation of the Compaſſe) that it cannot otherwiſe be, but that the ordinarie Charts are in many places much

much like an inextricable labyrinth of error, out of which it will be very hard for a man easily to vnwinde himselfe.

Hereto accord the often experiments and vsuall practise of many well experienced and iudiciall mariners and seamen of our time, who confesse that in sailing from the West Indies to the Azores, they haue often fallen with those Ilands, when by their account, according to the Chart, they should haue been 150, or two hundred leagues to the westwards of them. The like hath been found in sailing from the Azores for *Vshent*, as I haue also partly seene in the little experience I haue had at sea; where wee were come within sight of that Iland, when by account of the ordinarie Chart we should haue been fiftie leagues short of it.

And as concerning the courses from place to place, I haue obserued that some of our masters take a wise course, in not trusting to those courses which are shewed by their Charts. But first getting themselues into the height or parallel of ŷ place to which they are going: and withal knowing assuredly whether they be more Eastward or Westward then that place; they then proceed, alwaies heedfully keeping themselues vnder that parallel till they come to the place desired. Then which way of sailing there is none more certaine and infallible, for the sure finding of the place assigned: but it hath this inconuenience, that it maketh the way longer then otherwise it should be, if the straight course were kept.

But to returne to that from whence wee haue a little digressed: by these experiments and practise of

the skilfulleſt mariners, it is manifeſt that they themſelues doe often finde the imperfections of their Charts, in ſhewing the courſes and diſtances of many places each from other, wherto we may adioyne the experience of the beſt Hydrographers of our time, who daily making their Charts after the accuſtomed manner with ſtraight lined rumbes and degrees of latitude euery where equall, haue found ſuch difficulties in labouring to bring their marine deſcriptions to ſome due correſpondence of truth in the courſes, heights, and diſtances; that tired herewith in the end, they haue holden it impoſſible, to make the Chart agree in all theſe with the Globe. Wherein notwithſtanding they erre, by making too generall a concluſion, in holding that to be ſimplie impoſſible, which cannot be done by ſuch a way and meanes as they know and vſe.

3 The Croſſe-ſtaffe the principall Inſtrument, that hath at ſea been moſt generally vſed, for obſeruing the altitudes of the Sunne or ſtarres, thereby to know more aſſuredly the latitude, and ſo to examine and rectifie the account of the courſe kept by direction of the Compaſſe vpon the Chart, if there be not abatement made anſwerable to the eccentricitie of the eie (that is, to the diſtance wherewith the center or point wherein the ſight beams concurre within the eye is further backward then the end of the ſtaffe) may through neglect of this abatement cauſe error in taking the height obſerued to bee greater then indeed it is by 10, 20, 30 min. yea an whole degree, and more ſometimes, if the height be much, the ſtaffe ſmall, & the eccentricitie of the eye great.

4 But

4 But both this ſtaffe and all other Inſtruments (though neuer ſo well made and vſed) can do vs but ſmall pleaſure, for finding the latitude at ſea, if the declination of the Sunne and ſtarres which wee obſerue bee not alſo knowne. To this end therefore there haue been made tables of the declinations, both of the Sun and fixed ſtarres: yet ſuch as euen that which hath been publikely commended, as not differing from truth in any place aboue one minute (I meane the Regiment of the Sunne, ſet foorth by *R. N.*) doth notwithſtanding differ from truth in many places eleuen, twelue, or thirteene minutes. And as for the fixed ſtarres, ſcarce one of them hath his declination truly ſet downe, and agreeably to obſeruation. Yea euen the Pole-ſtarre it ſelf, though it be better knowne and more obſerued by the moſt part of ſeamen then all the reſt; and indeede as it mought be vſed (being to be obſerued at any time of the night all the yeere long) might ſtand them in as much ſtead for finding the latitude as al of the reſt almoſt: yet in the bookes of Nauigation that are moſt common amongſt Engliſh mariners, the diſtance thereof from the Pole is made to be in our time aboue 40 minutes more then it ſhould be. No maruell therefore if the mariners complaine (as I haue heard them ſometimes) that they cannot make their obſeruations of the latitude, by the Sunne and this ſtarre to agree.

Neither is there more truth to be looked for in the declination of many other principall fixed ſtars, publiſhed in thoſe bookes, diuers of them erring from truth one, two, yea (ſome of them) three whole

degrees and more, as in the treatiſe following ſhall be ſhewed. And theſe errors in the declination of the Sunne and fixed ſtarres, not only I, but alſo the right worſhipfull Sir *Chriſtopher Heydon* Knight, and the noble Lord of *Knudſtrupp Tycho Brahe* founder of Vraniburg, with the gratious Prince *VVilliam Landtgraue* of Haſſia, father of him that now is, haue often found by many and moſt diligent obſeruations, with large and exact Inſtruments, wherein both minutes and halfe minutes might bee eaſily diſcerned. Notwithſtanding, if any ſtand in doubt hereof, I wiſh that hee himſelfe alſo would beſtow no leſſe coſt, time and diligence to make often heedfull and exact obſeruation; then either the Prince of Haſſia, or *Tycho Brahe*, or at leaſt as I my ſelfe haue done; and then, let him beleeue that which he ſhall ſee to be true with his owne eyes.

Theſe errors therefore in the Chart, Compaſſe, Croſſe-ſtaffe, and declinations of the Sun and ſtars, I haue in the treatiſe following laboured to reforme to the vtmoſt (yea rather beyond the vtmoſt) of my poore abilitie, neglecting in the meane time other ſtudies, and courſes that might haue been more beneficiall to me: which may argue my good will to haue proceeded further, to the amendment of ſuch other faults and imperfections as yet remaine, beſides thoſe that are alreadie ſpecified, and that eſpecially in two points, that is, in the courſes, and longitudes of places.

The reforming of the Chart in reducing all places from thoſe varying courſes, wherein now they are ſet downe, to the true poſitions they haue each

from

from other, by ſeparating the variation (wherewith they are in the ordinary Charts for the moſt part intermingled) were a buſie peece of worke: yet ſuch as were moſt worthie, and neceſſarie to be laboured in, as without which the Charts, Maps, and Globes, or any other Hydrographicall, or Geographical deſcriptions, cannot be freed from many intricate abſurdities, wherewith now they muſt needes in many parts be peſtered: becauſe the courſes and poſitions of places are in them ſet downe as they were obſerued by the varying Compaſſe, without ſeparating the variation afterwards, that ſo the true courſes and poſitions of places might be knowne.

The longitude alſo would well deſerue both labour and coſt to be both skilfully and liberally beſtowed, for the finding thereof, whereby it were poſſible to bring it to that paſſe (the motions of the Sunne and Moone, and places of the fixed ſtarres being verified, whereof that noble *Tycho Brahe* hath affoorded great hope) ẏ the induſtrious and willing minded mariner might be capable thereof, in ſuch ſort that for the moſt part, when the Moone & fixed ſtarres appeare, he might be able hereby to know what longitude he is in (yea euen at ſea) more truly then many haue done by their dead reckonings in ſailing out of the bay of Mexico to the Azores, or from New-found-land to England, or almoſt from the Azores to England. But on land the longitude might by this meanes be found as exactly as the latitude hath been by many obſeruers at ſea. And ſo opportunities of obſeruatiõ with meet inſtruments on ſhore, not being neglected, (eſpecially in long

voyages, farre Eaſtward or Weſtward) many moſt notorious errors in the longitudes of places would in ſhort time be corrected, wherewith the moſt excellent arts of Geographie, and Nauigation are very much blemiſhed. For who that loueth truth, can patiently endure to heare the mariners common, and conſtant complaint of 150, or 200 leagues error in the diſtance between the bay of Mexico and the Azores? or (that which is yet moſt intollerable and monſtrous) of 600 leagues difference in the diſtance betweene *Cape Mendoſino* and *Cape California*, ſome making that diſtance to be twelue or thirteene hundred leagues, where others will haue it (and that more probably) to bee no more then ſix or ſeuen hundred.

But for as much as the charge, though not great, (to ſpeake of) of prouiding meete meanes for ſupply of theſe wants in the courſes and longitudes, (but chiefly in the latter) exceeds the meane abilitie of the moſt part of them that are moſt addicted to theſe vngainfull ſtudies (I muſt not ſay vngratefull, although in theſe daies they proue moſt vnprofitable to their greateſt louers) therefore they are for my part like to reſt (as hitherto they haue done) vntouched, and only commended vnto a certaine kinde of hope (whether vaine or no I know not) of ſome Mecænas at length of munificent ſpirit to be ſtirred vp, to haue ſome due conſideration both of theſe, and other ſuch wants and imperfections, as yet remaine in ſo excellent an art as this of Nauigation is.

For ſurely there is no man (conſidering how many

ny other both ingenious and ingenuous, as well liberall as mæchanicall Arts doe yeeld their aide and ſeruice vnto this of Nauigation) that can denie the excellencie thereof, or the profitablenes either. But if he will, my purpoſe is not to ſtand vpon it, nor to conuince him by reaſons, by records, or by the more wonderful diſcoueries that haue bin performed in this our age, euen to the furtheſt parts of all ỹ earth, and round about the whole compaſſe of the ſame, whereby we haue been made partakers of the moſt rare and richeſt commodities and treaſures of the vtmoſt Indies and Ilands of the world, and they likewiſe haue participated with vs (or elſe they haue had the more wrong) in the moſt precious treaſures of heauenly truth. All which and much more then can be thought, or now ſpoken of, performed chiefly (next vnder Gods prouidence) by the rules and directions of this art, who ſeeth not that by how much the more excellent, and vnto mankind abundantly profitable it is, ſo much the leſſe ought any notorious error to be tolerated therein, and ſo much the more ought all whom it may concerne (yea but in good will only where it may doe good) to endeuour themſelues that it may be brought to the higheſt pitch of perfection. I know not then if any one be vnto ſo excellent an enterpriſe drawne on to giue the beſt furtherance hee can, why he ſhould for his labour fall into any danger of reprehenſion at all. Yet it may be, I ſhall be blamed by ſome, as being too buſie a fault-finder my ſelfe. For when they ſhal ſee their Charts and other Inſtruments controlled, which ſo long time haue gone for currant, ſome of them

them perhaps will ſcarcely with patience endure it. But they may bee pacified, if not by reaſon of the good that enſueth hereupon, yet towards me at the leaſt, becauſe the errors I point at in the Chart, haue been heretofore complained of by others, eſpecially by *Martin Corteſe*, and *Petrus Nonius*, out of whom moſt part of the firſt Chapter of the Treatiſe following is almoſt word for word tranſlated; I for my part deſiring rather that faults ſhould be found by others then by my ſelfe, and labouring much more, as for a thing much better, and farre more needfull, and profitable, to be a fault-mender, then a fault-finder. Or elſe I may ſo much the more be miſliked, becauſe in ſeeking to amend, ſome will thinke I take too much vpon me: For ſome will ſay, and of thoſe perhaps that haue been employed in ſea affaires all their life long, that all this we goe about is more then needs. For they without all this ado haue euer performed their charge with good ſucceſſe, and are now too old to giue eare to theſe innouations and new ſchoole trickes. But other ſeafaring men who acknowledge the need hereof, are aſhamed peraduenture to receiue (as it were) either correctiõ from the ſchooles, or direction from the land: and therefore ſtick not to condemne Vniuerſities, and all in compariſon of their long and daily experience. Others alſo as more indifferent for the matter, will yet haue a fling at the perſon, thinking this reformation, which is profeſſed, to ſpring out of other mens fountaines: All which (becauſe wee are now about a work of amendment) muſt alſo (if they will heare reaſon) amend their opinions. For the

firſt,

firſt, which ſeeme moſt vnreaſonable, doe not conſider (being addict to theſe vnreformed Inſtruments) how like they are to thoſe old ſhip-maſters, of whō Maſter *Bourne* maketh mention, who not many yeeres ſince, wedded likewiſe too much to their old accuſtomed vſage, haue mocked them that haue vſed Charts, or Croſſe-ſtaues, ſaying, they cared not for their ſheep skinnes, they could keepe a better account vpon a boord: and them that obſerued the Sunne or ſtarres for finding the latitude, they would call Sun-ſhooters, and Star-ſhooters, and ask if they had hit it. But marke what commeth hereof: for one of theſe Maſters was he, as I take it, of whom an ancient ſeaman (yet liuing, as I thinke) once told me, who hauing vndertaken the charge of conducting a ſhip from *England* to Saint *Michaels*, (the eaſtermoſt of the Azores) and after long ſeeking, not able to finde it, for ſhame and ſorrow caſt himſelf ouer boord. Wherefore theſe men, if they conſider it well, haue no cauſe to boaſt of ſucceſſe without skill; but to thank God for both, that is, for their great and often good hap and ſafetie, and for their skill alſo were it ſmaller then it is. For I will do them no wrong, but doe freely grant and acknowledge, that from any one place to other, the courſe, height and diſtance may be truly ſet downe in the ordinary Chart, wherein the Rumbes are right lines, and the degrees of latitude euery where equall: and ſo by that Chart they may ſaile truly enough from hence to *Ruſſie*, or *Iſland*, or any other place. But if by the way they ſhould croſſe ouer from the one to the other, following the direction that their Chart ſhew-

eth

eth them, they cannot but erre a great deale, either in course or distance, or both; especially in those Northerly nauigations. Why then should they, where there is danger of wandring, refuse helpe of any that is willing to shew a better course?

But to come to those that may perhaps obiect I doe but *actum agere*, in doing no more then hath bin done alreadie by *Gerardus Mercator* in his vniuersall Mappe of the world many yeeres since: and in publishing something already set foorth by *Iodocus Hondius*, in his greater Mappe of the world and of Europe, now of late: I must answer, that indeed by occasion of that Mappe of *Mercator*, I first thought of correcting so many, and grosse errors, and absurdities, as I haue alreadie touched, and are hereafter at large shewed in the common Sea-chart, by increasing the distances of the parallels from the æquinoctiall towards the Poles, in such sort, that at euery point of latitude in the Chart, a small part of the Meridian might haue the same proportion almost to the like part of the parallel, that it hath in the Globe. But the way how this should be done, I learned neither of *Mercator*, nor of any man else. And in that point I wish I had been as wise as hee in keeping it more charily to my selfe. For so perhaps it might haue been more beneficiall to me: neither should any man haue had cause to thinke at the first sight of the fourth Chapter of this booke, that all I haue there set down is stollen out of one of the foresaid Mappes of *Iodocus Hondius*. But were I brought before a Iudge, I should for my absolution, and *Iodocus* his condemnation, make the contrary to appeare,

and

and that by his owne confeſſion in his letters to me, and to a friend of mine, which I haue to ſhew, written in Latin with his own hand: To me his writing engliſhed is thus much in effect:

I heare that you are ſomewhat offended with me, becauſe I haue taken thoſe few things out of your manuſcript booke, whereas I promiſed you that I would not publiſh it: which alſo I would in no wiſe doe without your leaue. For my conſcience ſomething grudged, euen to publiſh this little, if the diſtance of places would haue ſuffered me conueniently to ſend letters vnto you. I was purpoſed to haue ſet this foorth vnder your name: but I feared that you would be diſpleaſed therewith, becauſe I haue but rudely tranſlated it into Latin.

And in a letter to M. *Briggs*, now Profeſſor of Geometrie in *Greſham* Colledge, he writeth thus:

I haue written to M. *Wright* in excuſe of my ſelfe; I am very ſorrie that hee is angrie with me for that cauſe. I pray you learne of him how hee is affected towards me, and write backe vnto me, and excuſe me vnto him as much as you can. I would haue publiſhed his whole booke for the common good, if I might haue done it without breach of my faithfull promiſe. And ſurely my conſcience grudged to publiſh euen this little which I haue taken out of his booke: but the profit thereof moued me, &c.

The trueth is, that at his owne inſtant requeſt, when hee wrought as an Ingrauer here at London, ſome of my friends alſo, procured by his flatterie, perſwading me thereto, hee alſo aſſuring me vpon his faith and credit that he would not publiſh it, or

any

any part thereof without my knowledge and consent. But how well and honestly he hath performed that protestation grounded vpon faith and credit, the world may now see: and how vnthankfull hee hath been to me for that which hath been so gainfull to himselfe, (as may appeare by so common sale of his Mappes of the world, of Europe, Asia, Africa, and America, al which had yet been vnhatched, had he not learned the right way to lay the groundwork of them out of this booke) I my selfe know too well. But let him goe as he is.

Now if any shall thinke it to be beyond a landmans skill, to finde faults in matters belonging to the seamans profession; they must know, if they be yet to learne, that one that is but reasonably well acquainted with Geometricall conceits, may as well, if not better then most seamen, know the nature and properties of the sphæricall forme of the earth and sea, with all consequents and dependances thereof. By consideration whereof, the true vnderstanding and reason of the nautical planisphere, or Sea-chart, may by him that hath been but meanly conuersant in Mathematicall meditations, be better apprehended, then otherwise it can by the seafaring man, though he spend his whole life in sailing ouer all the seas in the world. The like may be said of ỹ Crosse-staffe, and Compasse, and of the regiments or tables of declination of the Sunne and fixed starres, and of all other the principall meanes and Instruments seruing for the Art of Nauigation. But it is strange to see the differēce of things that in this world is made by the difference of hands from which they are receiued,

ceiued, howſoeuer the things themſelues be. For let *Hannibal* a Captaine diſcourſe of warlike affaires, be it neuer ſo ſlightly and out of reaſon or ſeaſon, yet all (forſooth) muſt needes be greatly eſteemed and admired, becauſe he ſo great a Captaine hath ſpoken it. But let *Phormio* a Philoſopher ſpeake of the ſame matter, eſpecially in the hearing of *Hannibal*, be his ſpeech furniſhed with neuer ſo much learning and iudgement, yet muſt he (there is no remedie) be either a foole or a madman for his hire. So by all likelihood, the caſe may ſtand with this poore Treatiſe of mine; which if it had come forth to publike view, from out of the boſome (as once it was like) of a Maſter at ſea, of great reputed excellencie, it had no doubt then found ỹ fauour, which now like enough it ſhall want: all windes then would haue ſweetly blowne it into the pleaſanteſt hauen of euery mans (at leaſt of euery ſea-mans) fauourable entertainment. I ſhall therefore with their patience ſet down the matter as it was, that none may miſtake a trueth, which is daughter, not only of time, but of occaſion, as hereby may appeare. It is not vnknowne to ſome of good place and reckoning, that one of the skilfulleſt Nauigators (as hee was by many accounted) of our time & Nation, (who died in Sir *Francis Drakes* laſt voiage) when he came to that extremitie of ſicknes, that hee ſaw there was no other way with him but one, was reported to haue gathered and bound together into a bundle all his nauticall notes and obſeruations, and to haue caſt them into the ſea. But ſoone after, notwithſtanding that report, there came more comfortable newes by a Captaine that was familiarly

miliarly acquainted and conuerſant with him in all that voyage, and during the whole time of his ſickneſs, in whoſe armes alſo he died: who mouing ſome ſpeech vnto him touching ſomething of Sir *Francis Drakes*, that might then after his death be expected to come to light concerning Nauigation; Tuſh (ſaith hee) for that matter there is not much to be looked for at his hands, he had but ſmall skill in that art. Why, and what will your ſelf then doe? (quoth that Captaine) Whereupon this great Nauigator drew foorth a booke out of his boſome, and deliuered it to this Captaine a little before his death. This booke was ſhewed by the ſame Captaine to the right Honourable the Lord high Admirall of England in the Cales voyage, as being made by that famous Nauigator, which his Lordſhip alſo (as it was reported) thought good ſhould be peruſed & publiſhed. Theſe newes moued ſome expectation of that booke: ſo as the right Honorable the Earle of *Cumberland* hearing of it, was deſirous alſo to haue a ſight thereof, and remembred me vnto that Captaine, as one not inſufficient to peruſe and correct the ſame. And hereupon the booke was brought vnto his Lordſhip, at the time and place appointed at *Weſtminſter*, and was there alſo deliuered vnto me to be peruſed and corrected. Hauing therfore opened it, & beginning a little to turne ouer the leaues, to take ſome generall view what matter might be contained therein: I firſt eſpied a Diagram, the like whereof I knew very well I had made in a book of mine. And herewithall I was the more moued to ſee if there were any more that I could know as well

as

as the former: turning ouer therefore two or three leaues more, I presently espied another figure also, wherewith I was as well acquainted, as with the former: for I found not only the very same figure, but (that which made me the more to maruell for the present) following also in the same order, as I well remembred it did in my booke. Being therefore yet more earnestly stirred vp hereat, and wondring what the reason might be, that we should thus agree, I betooke my self to the reading of that booke. And looking first vpon the first leafe thereof, and afterwards in many other places, I found it euery where to agree with mine, and to be a copie of the same booke, word for word, which I made, and presented vnto his Lordship almost seuen yeeres before, as the next morning it plainly appeared, both to his Lordship and to the Captaine himself that brought it, by comparing it in all points, with the originall exemplar of the same booke, which I then brought vnto his Lordship.

One crime there yet remaineth which *Simon Stevin* of late hath charged me with in the former edition of my tables of Rumbs, namely, that I haue erred about 12 minutes in the latitude of the fourth rumbe at 78 degrees of longitude, and aboue two minutes in the latitude of the first rumbe from the meridian, before I come to so little as two degrees of longitude: whereby hee would prooue that my way of making the table of Rumbes should be erroneous. But the truth is, the error is not so much in my tables, as in his own too rash vnaduisednes, who out of no better ground then so grosse a manner of

triall, as hee vseth in finding out the latitudes of the Rumbes working by whole degrees of longitudes, would make the world beleeue I had committed so great errors in those tables; which latitudes if hee had sought by single minutes, he should not by his owne way and manner of account haue found so much as the sixtieth part of one minute difference from my way whereby I made those tables; which as it is of all other the most easie, so it is not inferiour in truth to any way that he hath or can deuise: his account, according to his owne waies, yeelding alwaies more then trueth, and mine something lesse; and yet not differing so much as one second one from another, if you worke his way exactly by small differences of longitude.

But I feare that whilest I labour to satisfie all, I shal offend some, as making too long a Preface to so smal a volume: I will therefore hasten to an end, only shewing ỹ summe of this Treatise: which I thought good to offer vnto your view, as a short abridgement of all that followeth, and rather to set it apart by it selfe, then to include it, as I was purposed, within this Preface, which is beyond his bounds alreadie.

The summe of the Treatise following.

THe Treatise following containeth foure principall parts; whereof the first may be called Hydrographicall, wherein are set downe the errors of the common Sea-chart, with right lined rumbs, and degrees of latitudes euery where equall: then the

way

way to auoid theſe errors is geometrically demonſtrated, and out of this demonſtration a Table is calculated, and the uſe thereof ſhewed, for the true and eaſie diuiding of the Meridians in the Chart, both generall and particular, into ſingle minutes of latitude, increaſing in due proportion towards the Poles, whereto is adioyned, as ariſing from thence, the Table of the ſeuen firſt Rumbes, ſhewing by what points of longitude and latitude each of thoſe Rumbs is to be drawne, from the æquinoctiall till you come within a minute of the Pole: with helpe of which Tables, the Rumbes may in any Chart, Mappe, or Globe, much more truly be deſcribed, then by thoſe mæchanicall waies, long ſince publiſhed by *Petrus Nonius*, or lately practiſed by ſome Globe-makers in England. To which is annexed a table of the eighth Rumbe, ſhewing the quantitie of one degree of longitude at any latitude, in min. ſeconds and thirds of one degree of the æquinoctial. Which degree of longitude being diuided by 3 at any latitude, giueth you the number of leagues contained in one degree of the parallel at that latitude. By meanes of this table, the table of Rumbes may (according to *Steuins* way) be more truly and eaſily made or examined, then by that which he hath lately ſet foorth, 4 *libr. Geogr. de Hiſtiodromia.* After this followeth a moſt plaine and ſenſible demonſtration of the diſagreement of the common Sea-chart, and of the agreement of the Globe with the Chart before deſcribed, the vſe of which Chart is ſhewed in the Chapter next following: where alſo (the longitudes and latitudes of any two places being gi-

uen) the way is ſet downe how to finde their diſtance, meaſured either in the ſegment of the rumb, or in the arch of the great circle that is drawne betweene them, both mechanically with ruler and compaſſe, and mathematically by the doctrine of triangles; whereby it may without much difficultie be conceiued how Nauigation may by Arithmeticall calculation only be performed without Chart or Globe, the longitudes onely and latitudes of the places from whence you come and whither you goe, being firſt knowne.

The ſecond principall part of this Treatiſe may be called Magnetical, becauſe it intreateth of the variation of the Compaſſe, ſhewing how the ſame may be found at ſea (the latitude being giuen) by one obſeruation of the Sunnes height, and point of the Compaſſe whereupon he is at the ſame inſtant, before or after noone, with helpe of the Globe or Aſtrolabe: which way of finding the variation is alſo exemplified, with a Table of ſuch obſeruations as I tooke both at ſea and on ſhore, in the voyage of the right Honorable the Earle of Cumberland, in the yeere 1589. But this way of finding the variation, being ſomething tedious, I haue now therefore hereto newly adioyned the making and vſe of the ſeamans rings; an Inſtrument which long ſince I deuiſed for the preſent finding both of the variation and time of the day, at one inſtant, euen together with the obſeruation, without any further trouble of vſing any other Inſtrument, or working, either mechanicall or Arithmeticall after you haue obſerued. Yet becauſe theſe Rings, and the Globe

and

and Aſtrolabe alſo are ſuch Inſtruments as euerie one cannot eaſily haue and vſe at ſea; I haue further ſhewed how by the Sunnes point of the Compaſſe (or Magnetical Azimuth) and altitude giuen by obſeruation the variation may be found, either mechanically, with ruler and compaſſe, or mathematically by the doctrine of triangles, and arithmeticall calculation. And ſeeing moreouer that of late yeeres, diuers induſtrious ſeamen of our nation, haue begun to make ſome obſeruation of that new found propertie of the magneticall needles inclination, or dipping vnder the Horizon, after it is touched with the Loadſtone; by meanes whereof, it ſeemeth ſomething probable, that ſeamen may haue ſome help to know their height or latitude in darke and cloudie weather, when neither Sunne, nor ſtarres for many daies appeare, to be obſerued: I thought it ſhould not be impertinent to this place to ſet downe the Theorick that hath been deuiſed of this magnetical inclination, together with a demonſtration for the making of a table thereof, to euery degree of latitude, according to that Theorick: to the end that ſuch of our ſea-men as meane to be diligent obſeruers hereof, may make heedfull triall of that inclining propertie, and compare the ſame with this table, in all parts of the world where they ſhall trauell; eſpecially in thoſe long voyages to the Eaſt & Weſt Indies, and in their Northeaſt or Northweſt diſcoueries.

The third part may be called Geometrical, intreating of the Croſſe-ſtaffe, and ſhewing how ſuch errors may be auoided, as haue been commonly com-

mitted in the vſe thereof, either by reaſon of the parallax, or eccentricitie of the eye, or by the height of the eye aboue the water, or by the parallax or refraction of the Sun. And becauſe for finding the quantitie of the angle that is to be abated out of the apparent altitude of the Sunne or ſtarres, obſerued by this ſtaffe, for any height of the eye aboue the water; it was needfull to know the quantitie of the earths ſemidiameter, concerning which there is great varietie of opinions amongſt learned authors: I haue therefore in this part of this treatiſe now ſhewed diuers waies for the more certaine finding thereof; one of which waies I haue alſo for my more aſſurance exemplified by obſeruation, as meanes and opportunitie ſerued me, neere Plimmouth ſound, *anno* 1589.

The fourth and laſt part may be called Aſtronomicall, wherein my chiefe intent was to correct the errors that are in the ordinary Tables of declination of the Sunne, and fixed ſtarres. To which end there is firſt ſet downe a table of the declination of euery minute of the ecliptick, in degrees, minutes and ſeconds, calculated for the greateſt obliquitie of the Zodiack, as it is found by obſeruation in this age, 23 degrees, 31 minutes and an halfe. Whereto is adioyned the vſe thereof for the readie finding of the place of the Sun by his declination giuen: or contrariwiſe for finding the Suns declination, his place being firſt knowne. After this is ſhewed the way and meanes I vſed for exact obſeruation of the Suns Meridian altitudes, with a table of thoſe obſeruations, for foure yeeres together, that ſo the more

certaintie

certaintie might be had of the declinations and places, and consequently of the whole course and motion of the Sunne: and that by comparing together so many obseruations, the Sunnes eccentricitie and apogæum might the more assuredly be knowne. By knowledge whereof, the way was laid open for the correcting, and true making, of the Tables of the Suns middle motions and prosthaphæreses, which were necessarie helpes and meanes for calculating the Ephemerides of the Sun there set downe: without which the regiment or table of declination of the Sunne next following (which I may commend as free from error obseruable at sea, and seldome differing one minute from obseruation on land, and for which principally all the former paines were vndertaken) could not so easily haue been made. Now if any shall thinke that most of this fourth part going before this regiment, might haue been omitted, as being impertinent to the vse of mariners, and exceeding their capacitie: I answere, that it was not my purpose, neither could I in all places applie my selfe to the most part of sea-mens capacitie, knowing many that would not be content with this regiment alone, but that desired more to know the ground and roote from whence this fruit grew: whose desire I was also willing to satisfie as I could for the present, hauing seldome had a more inconuenient season for such a purpose. Then after some caution giuen, concerning the vse of this table of declination, and the æquation thereof in places farre differing in longitude from hence, there followeth a table of 32 principall fixed starres about the æquinoctiall,

ctiall, that haue been moſt commonly knowne and obſerued by ſeamen with their declinations corrected: and another table of as many more of the notableſt ſtarres about the North Pole is thereto annexed, with their diſtances from the Pole, corrected alſo and verified by diligent obſeruation on land. To theſe is added a Table of the Sunnes right aſcenſions (reſolued into houres and minutes) for euery day of the yeere with the vſe thereof, for finding at what houre any of thoſe ſtars commeth to the Meridian at any time of the yeere: that hereby the mariner might finde at all times, when they come to the Meridian, and ſo the eaſilier learne to know and obſerue them. Hereunto I haue newly adioyned the deſcription and vſe of an Inſtrument which may not vnfitly be called a Sea-quadrant; whereby is ſhewed, how the height of the Sunne at ſea, may by two obſeruers, be much more exactly obſerued, then by any other meanes before publiſhed: and how the height of the Pole may readily be found at any time of the night, by obſeruation of the Pole-ſtarre and guard, without making any abatement or allowance (as the manner hath been) in regard of the point of the Compaſſe, whereupon the guard is ſituate. But now for further ſatisfaction in euery one of theſe particulars, I referre the friendly reader to the Treatiſe it ſelfe heere following. Which *Simon Stevins* inconſiderate deſire of finding fault with my tables of Rumbes, hath cauſed me to conclude with an Anſwere to him, plainly ſhewing himſelfe, and not me, to be in the ſame fault that he would finde with me.

To

To this treatiſe (for the benefit of the younger and vnskilfuller ſort of ſeamen) it was thought not vnmeete to adioyne the ſhort treatiſe following, containing the ſumme of the whole art of Nauigation, firſt ſet foorth in Spaniſh by *Roderigo Samorano*, and ſince tranſlated into Engliſh, by a friend of mine, for the benefit of our Nation: which treatiſe I would wiſh all them that are but nouices, or new beginners in that Art, firſt to peruſe, and vnderſtand well, before they come to the reading of the former, which (for the reading thereof with the greater profit) requireth ſuch a one as is alreadie reaſonably well acquainted with the rules and principles of that Art; which I haue not hitherto knowne to be more briefly and plainly, nor yet more fully ſet downe and publiſhed in any other booke, then they are in that little treatiſe. This notwithſtanding I muſt admoniſh the Reader, that in ſtead of the Sea-chart therein deſcribed, according to the common error, with equall degrees of latitude, he follow that manner of making the ſame, which I haue in the former treatiſe ſet downe, Chap. 3, 4, 5, and 6. And that in ſtead of the rules and allowances for finding the latitude by the height of the Pole-ſtarre (which are many waies, and much erroneous) he muſt follow the tables adioyned to the end of that treatiſe; which for any of thoſe 8 poſitions of the guards, at which ſeamen vſe to take the height of the Pole-ſtarre, doe in any latitude truly ſhew the height of the Pole by the height of the Pole-ſtarre truly obſerued. Which tables, together with ſome others in the former treatiſe; as namely, that of the declination

tion of euery minute of the Eclipticke in the 17 chapter, together with those of the sunnes Prosthaphæreses, and Ephemerides in the 22 and 25 chapters, as also that of the suns declination chapter 27: I could not by reason of my many distractiõs intend to make my selfe: but was enforced to procure my kind friend M. *Henry Brigs* to vndertake that labour for me: which notwithstanding (I perswade my selfe) many will thinke might well haue been spared; being all vndertaken vpon no greater occasion then the error of one minute and a halfe in the sunnes greatest declination, which (by following the example of *Copernicus* and others, the chiefest Arts-maisters in Astronomie, in not regarding the sunnes parallax, when by his solstitiall altitude, and the height of the Pole, I sought the obliquitie of the Zodiack, and distance of the tropicks) was committed in those tables in the former edition of my booke of *Errors in Nauigation*.

But howsoeuer I may perhaps for this cause be censured by some, of too much curiositie; yet this I am sure of, that all Mariners and Sea-men, and whosoeuer else shall haue occasion to make vse of this booke, haue iust cause to thinke well of my carefulnesse herein; who would haue so much labour vndertaken, as to haue all those tables with great diligence newly calculated throughout: rather then so small a fault as that should in this edition also, passe on vncorrected. This labour therefore together with the rest, I commend to thy friendly acceptance. Farewell.

A TABLE SHEWING THE CONTENTS OF THIS Treatiſe.

Chap. 1. *Faults in the common Sea-chart with rumbes expreſſed by right lines and degrees of latitude euerie where equall.* pag. 1

1 *Error in the proportion of the length and breadth of places in the common Sea-chart.* 1

2 *Error in finding out the difference of longitude by the common Sea-chart.* 2

3 *Error in the lying or bearing of places one from another in the common Sea-chart.* 6

4 *Error in ſetting of places out of the common Sea-chart into the Globe.* 7

5 *Error in ſhewing the diſtances of places in the common Sea-chart.* 7

6 *Some error in keeping alwaies the ſame point of the Compaſſe in ſailing.* 8

The expreſſing of the rumbes by right lines defended, which ſome hold for erroneous. 10

Chap. 2. *How the former errors may be auoided.* 12

The definition of the Nauticall planiſphære. 14

A table of the latitudes of euery minute of a Meridian of the Nauticall planiſphære or Sea-chart, in ſuch parts whereof each minute of the æquinoctiall containeth 10,000. *pag.* 21 *&c.* 21

Chap. 3. *The vſe of the two firſt columnes of this table of latitudes, for graduating a meridian in the generall Sea-chart.* 113

Example of the graduating of a meridian in the generall Sea-chart. 115

Chap. 4. *Another way for graduating the meridian of a generall Sea-chart.* 116

Chap.

The Contents of this Treatise.

Chap.5. *The vse of the table of latitudes, for the true graduating of a particular Sea-chart.* 118

Chap.6. *The breadth of a particular Chart being giuen, to diuide the same into the degrees and minutes, contained in the difference of the least and greatest latitudes therein to be expressed.* 121

Chap.7. *The vse of the third columne of the table of Latitudes.* 123

An easie way to reduce the difference of longitude into leagues. 124

Chap.8. *How to describe the Rumbs mechanically in any Sea-chart, Globe, or Mappe, of what forme soeuer.* 125

Chap.9. *The vse of the table of latitudes for making the table of Rumbes.* 127

To finde presently the latitude of any rumbe for any longitude. 128

A table of the first Rumbe from the Meridian, that is, the Rumbe of North and by East, North and by West, South and by East, South and by West. 129

The second Rumbe from the Meridian, the Rumbe of North Northeast, North Northwest, South Southeast, South Southwest. 130

The third Rumbe from the Meridian, Northeast and by North, Northwest and by North: Southeast and by South, Southwest and by South. 131

The fourth Rumbe from the Meridian, Northeast Northwest, Southeast Southwest. 133

The fifth Rumbe from the Meridian: Northeast and by East, Northwest and by West, Southeast and by East, Southwest and by West. 136

The sixth Rumbe from the Meridian: East Northeast, East Southeast, West Northwest, West Southwest. 140

The seuenth Rumbe from the Meridian: East and by North, East and by South, West and by North, West and by South. 145

Chap.

Chap. 10. *The vse of this table of Rumbes.* 162
The vse of the table of the eighth Rumbe. 163
Chap. 11. *A most plaine and sensible demonstration of the agreement of the Nautical Planisphere, before described, with the Globe, and of the disagreement of the common Sea-chart from them both.* 164
Chap. 12. *The vse of the Nauticall Planisphere or Sea-chart.* 168
To know how one place in the Chart lieth from another. 168
To finde the distance of places in their rumbe. 169
If both places haue one latitude. 169
If both places haue the same longitude. 169
If both places differ both in longitude and latitude. 170
The demonstration of the truth of the former rules. 170
To finde the distance of any two places in the arch of the great circle drawne by them. 173
If both places haue no latitude. 174
If both places haue the same longitude. 174
If both places differ in longitude, and but one of them haue latitude. 175
If both places haue latitude of one denomination and equall. 178
If the latitudes be of one denomination and vnequall. 178
If the latitudes be of diuers denominations. 180
The demonstration of the former rules. 182
To finde the distance of any two places Arithmetically. 185
The Art of Nauigation Arithmeticall. 186
1 *By the longitudes and latitudes of two places to finde the rumbe and distance.* 187
2 *By the distance and latitudes to finde the rumbe and difference of longitude.* 188
3 *By the rumbe and latitudes to finde the distance and difference*

difference of longitude. 189
4 *By the longitudes, rumbe, and one latitude, to finde the other latitude and the distance.* 189
5 *By the rumbe, the distance, and one latitude, to finde the other latitude and the difference of long.* 190
Chap. 13. *Error in the vse of the Compasse by the variation neglected, and how to obserue & auoid the same.* 191
The making of the sea rings. 199
The vse of the sea rings. 205
Chap. 14. *To finde the inclination or dipping of the magneticall needle vnder the Horizon.* 209
A short way to calculate the table of magneticall inclination. 211
The table of magneticall inclination. 212
Chap. 15. *Errors in vsing the Crosse-staffe.* 213
1 *Error by reason of the eccentricitie of the eye.* 213
How it may be found and corrected. 214
2 *Error by the height of the eye aboue the water.* 216
To finde how much this error is at any height of ỹ eye.
First, without knowing the quantitie of the earths semidiameter. 217
Secondly, with knowledge thereof, found either by the highest meridian altitudes of the Sun. 218
Or by the meridian altitudes of some principall fixed starres. 220
Or by the shadow of a perpendicular stile. 220
The finding of the earths semidiameter by the height of some mountaine neere the sea. 221
Maurolycus *and* Clauius *his grosse demonstration hereof.* 222
A more exact demonst. with the practise therof. 225
The angle of dipping for any height of the eye. 229
3 *Error by the parallax of the Sunne, corrected.* 230
4 *Error in obseruing by the refraction of the Sunne or starres, corrected.* 232
Chap. 16. *Faults amended in the table of the Suns declination, commonly called the Regiment of the Sunne.* 233

Chap.

The Contents of this Treatise.

Chap.17. *Of the table of declination of euery minute of the Ecliptick in degrees, min. and sec. made according to the greatest obliquitie of the zodiack this present age; which by exact obseruation is found to be 23 degrees, 31 min. and an halfe.* 235

A table of the declination of euery minute of the Ecliptick, in degrees, min. and sec. 238. &c.

Chap.18. *The vse of the former table of declination.* 298

Chap.19. *The description and vse of a great quadrant, for obseruation of the Sunne on land.* 304

A table of obseruations of the Sunnes meridian altitudes, taken by the foresaid quadrant, in the yeeres 1594. 1595. 1596. 1597 at London.

Chap.20. *The finding of the Suns Apogæum and Eccentricitie out of the former obseruation.* 330

To know the time of the Suns comming to any point of the Ecliptick. 331

Chap.21. *The middle motion of the Sun, corrected out of the former obseruations.* 344

A table of the Suns middle motions. 347

Chap.22. *A new theorick of the Sun, for the making of the table of the Suns Prosthaphæreses.* 349

A table of the Suns Prosthaphæreses. 354

Chap.23. *The making of the Ephemerides of the Sun.* 356

Chap.24. *How to reduce the apparent time to the equall time answering thereto.* 360

A table of the æquation of naturall daies. 361

Chap.25. *A table of equations of the Suns Ephemerides to make them serue for many yeeres.* 362

Ephemerides of the Sunne. 363

Chap.26. *The vse of these Ephemerides.* 387

Chap.27. *The making of the table of the suns declinatiõ.* 388

Prosthaphæreses of the sunnes declination. 392

A table of the sunnes declination. 393

Chap.28. *The vse of the former table of declination, or Regiment of the sunne.* 423

Chap.

The Contents of this Treatise.

Chap.29. *The declinations of the principal fixed stars about the aequinoctiall, corrected by obseruation.* 427

A table of fixed stars about the aequinoctiall. 431

Chap.30. *The vse of the former table.* 432

Chap.31. *The true distãces of certaine principall fixed stars frõ the North pole, found by late obseruation.* 432

Chap.32. *To know at what time any of the foresaid fixed starres come to the Meridian for any day of the yeere.* 435

A table of the Sunnes right ascensions in houres and minutes for euery day of the yeere. 439

Chap.33. *By the former tables of fixed stars, and the Sunnes right ascensions, to know the houre of the night at any time of the yeere.* 440

Chap.34. *Of finding the eleuation of the Pole, by obseruation of the Pole starre and guard.* 441

Chap.35. *The description & parts of the Sea-quadrãt.* 444

Chap.36. *The descriptiõ of the nocturnal or night dial.* 446

Chap.37. *The vse of the Sea-quadrant: first in obseruing the height of the Sunne, looking only to the Horizon at sea.* 447

Chap.38. *How with this Quadrant to obserue the height of the sun, with your back turned towards ỹ sun.* 448

Chap.39. *How to obserue with this Quadrant the height of the sun or starre, looking both to the sun or starre, and to the Horizon.* 449

Chap.40. *How to find the height of the Pole by obseruation of the Pole-star and guard, without giuing or taking any allowance or abatement, at any time when the Pole-starre, the guard and Horizon may be seene.* 450

To know ỹ houre of the night by ỹ nocturnal. 451

An answere to Simon Stevin, *shewing his errors, in blaming me of error in my tables of rumbs.* 452

FINIS.

CERTAINE ERRORS IN NAVIGATION CORRECTED.

Chap. I.

Faults in the common Sea Chart, with Rumbes expreſſed by right lines, and degrees of Latitude, euery where equall.

AS the Sea Chart is one of the moſt principall Inſtruments that Mariners haue for their direction in ſailing, ſo there is not any wherein there are ſo great and dangerous errors.

Error in the proportion of the length & breadth of places in the common ſea chart.

1 For firſt, what places ſoeuer are deſcribed therein, the length of them (from Eaſt to Weſt) hath a greater proportion to the breadth (from North to South) then indeede it ought to haue (except it be at the æquinoctial.) And ſo much the more this error increaſeth, by how much the further diſtant thoſe places are from the æquinoctial: euen as the proportion of the Meridian to the Parallel, increaſeth the more, the neerer you come to either Pole; ſo that at the parallel of 60 degrees latitude, the proportion

of the length to the breadth is twice greater than indeede it ſhould be; and that becauſe the meridian is double to that parallel, and ſo in all the reſt, the proportion of the length to the breadth ſhall be greater then the trueth, in the ſame proportion, wherewith the meridian exceedeth the parallel.

As for example: in the common ſea Chart, the proportion of the length of Frieſland, to the breadth thereof, is two-fold greater than in the globe (which ſheweth the true proportion of the length to the breadth) becauſe the meridian is double to the parallel of that Iland. In the Ilands of Groenlant and Groclant, the length to the bredth hath a foure-fold greater proportion in the common Mariners chart, then it hath in the globe; becauſe the meridian is fourefolde greater then the parallel of thoſe places.

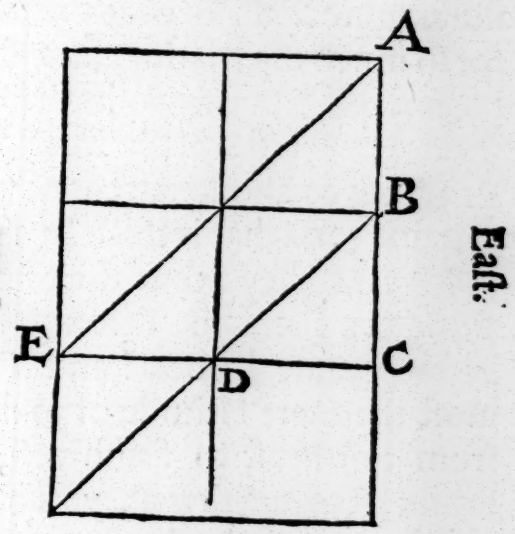
Error in finding out the difference of longitude by the common ſea Chart.

2 The way to finde out the difference of longitude, by the common ſea Chart, is true at the æquinoctiall onely, and neere about the ſame may bee vſed without ſenſible error: becauſe there onelie the meridian and parallel are æquall. But on this ſide or beyond the æquinoctial there is error committed proportionally to the difference of the meridian and parallel, that is, the difference of longitude found out by the Chart hath the ſame proportion to the true difference of longitude, that the parallel hath to the meridian.

As for example: at the parallel of 60 degrees in the common mariners Chart (wherein the degrees of the meridians, and parallels are equal) admit B D be two places bearing each from other ſouthweſt and northeaſt, differing in latitude ſo much as is the

arke

arke of the meridian B C, which for example ſake we will ſuppoſe to bee one degree, therefore by the ordinary Chartes the difference of Longitude C D, ſhall bee likewiſe one degree: but yet in trueth becauſe the meridiã is double to that parallel, and conſequentlie, a degree of the meridian double to a degree of that parallel, therefore B differing a degree in latitude from D ſhould bee placed twice ſo far from C, that is at A, ſo as A B C may all be counted but for one degree of the meridian, and ſo bee equal to two degrees of the parallel, whereof ſhould follow that E C ſhould be the difference of longitude, that is, two degrees, (as the trueth is in the globe) whereas the common Mariners Chart ſhew the difference of longitude to bee but half ſo much. And yet notwithſtanding if you goe nearer to the poles, you ſhal erre by their Chart a great deale more, euen as the proportion of the meridian to the parallel increaſeth more and more.



But this error in ſhewing the difference of longitude, ſhall yet further appeare by this example of *Petrus Nonius.*

In the Mariners Chart, the diſtance betwixt Liſbone and Tercæra, is ſet downe to bee 262. Spaniſh leagues (whereof 17 and one halfe make a degree of the æquinoctiall, or of any of the greateſt Circles) for ſo much the Mariners doe finde that diſtance to be, not onely by eſtimation of the way that the ſhip maketh, when they ſaile from Eaſt to Weſt to that Iland, but by another account which is much more certaine; and that is this. In ſayling from Lisbone to Madera, they keepe their courſe ſouthweſt, and from this Iland to Tercæra, they ſayle northweſt. Now becauſe Lisbone and Tercæra haue both almoſt the ſame latitude of 39 degrees: and in ſailing from northeaſt to ſouthweſt, and likewiſe from ſoutheaſt to northweſt, you alter the longitude as much as the latitude (becauſe that in both thoſe courſes the angle that the way of the ſhip maketh with the meridian, is æquall to halfe a right angle: and the Iland of Madera hath almoſt 31 degrees and an halfe of latitude towards the north, ſo that the difference of the latitudes of Lisbon and Madera, as alſo of Madera and Tercæra is about 7 degrees and $\frac{1}{2}$.) Therfore the difference of the longitudes of Lisbone and Madera, and likewiſe of Madera and Tercæra ſhall be 7 and $\frac{1}{2}$ of the ſame degrees of the meridian, both which added together make the whole difference of longitude betwixt Lisbone and Tercæra, to bee 15 degrees of the meridian, which are equal to 262, and one halfe Spaniſh leagues. But in the parallel that paſſeth by the 39 degree of latitude, wherein (almoſt) Lisbone and Tercæra are placed, there are more degrees in the ſame ſpace, according

to that proportion wherewith the meridian is greater then that parallel. Therefore the true difference of longitude betwixt Lisbone and Tercæra, that is, the arke of the parallel or æquinoctial conteined betwixt the meridians of those places shall thus bee found out:

It is a rule in Geometrie, that the diameters and peripheries, and consequently the semidiameters, and like arkes of circles haue the same proportion.

Also it is manifest that the sine of the complement of the distance of any parallel from the æquinoctial, is the semidiameter of the same parallel.

Now the distance of the parallel of Lisbone and Tercæra from the æquinoctial is about 39 degrees, the complement whereof is 51 degrees: whose sine is 777 which is the semidiameter of the foresaid parallel, in such parts whereof the whole sine conteineth 1000. which is the semidiameter of the meridian. Therefore by the rule of proportion inuersed, if 262 Spanish leagues make 15 degrees in the meridian, whose semidiameter is 1000 parts: then in the parallel whose semidiameter is 777 of the same partes, they shall make 19 degrees, and $\frac{237}{777}$ parts of one degree, that is, 18 min. and little more; which (if it be true that the course from Lisbone to Madera is southwest, and from Madera to Tercæra northwest: and that the latitude of Madera is 31 deg. 30 min. and the latitude of Lisbone and Tercæra 39 deg.) shall be the difference of longitude betwixt Lisbone and Tercæra. Whereas *Ortelius* and *Mercator* following as it seemeth the marine Chartes without correction in their vniuersal Maps, make them

to differ in longitude ſcarce 15 de grees of their parallel, as if it were æquall to the æquinoctiall line.

Errors in the lying and bearing of places one from another in the common ſea Chart.

3 Moreouer, they are deceiued not onely in the ſituation of many places, which the marine Chart ſheweth to be vnder the ſame Meridian: but alſo in the lying, or bearing of other places each from other. For the Meridian is a certaine rule of the poſitions of places. If therefore error ſhall bee committed in the ſituation of the Meridian, there muſt needes bee error in the inclinations of the other rumbes, pointes, or lines of the Compaſſe. And therefore not euery inclination, or reſpectiue poſition of place to place, which is ſet downe in the marine Chart, is to be taken for true: but that poſition or inclination onely, by which ſome haue ſailed from the one place to the other. This may be ſeene in ſayling to India. For the marine Chart placeth that promontorie of Africa, called the promontorie of 3 pointes, being in latitude towards the North, 4 degrees and one halfe, and the Ilands of Triſtan acugna (which haue 36 degrees of Southern latitude) vnder the ſelfe ſame Meridian: Alſo the marine Chart ſheweth the diſtance betweene theſe Ilands and the promontorie of Good Hope, to bee almoſt 400 leagues: both which notwithſtanding cannot ſtand together. For if all the ſhore from the promontorie of 3 pointes vnto the promontorie of Good Hope be rightly deſcribed, and the promontorie of 3 pointes alſo lie vnder the ſame Meridian with thoſe Ilands; the foreſaid diſtance muſt needes be much leſſe: But if it be not leſſe, it cannot bee that they ſhould haue the ſame

Meridian

Meridian with the promontorie of 3 pointes, but muſt needs bee more to the Weſtward. Hereof it commeth that the Mariners are very oft deceiued, when they go from one place to another, following that direction which the ſea Chart ſheweth them. Which place when they finde not by that courſe, they thinke that the cauſe of that error is either ſome ſwift current of the Sea, that carrieth them another way: or elſe the declination of the poles of the Loadeſtone, from the true poles of the world: although (perchance) they erred onely becauſe they knew not how thoſe places did beare one from another.

Error in ſetting of places out of the common ſea Chart into the globe.

4 Neither are they onely deceiued in that, becauſe they thinke that the ſea Chart can ſhew the ſituations of all places: but alſo becauſe that when they will tranſlate the ſea coaſtes out of the Chart into the Globe, they doe it, hauing reſpect onelie to the numbers of the degrees of longitude, and latitude found therein; and no otherwiſe then when they ſet the fixed ſtarres into a cœleſtiall globe. So it commeth to paſſe, that not onely thoſe errors are committed, which doe neceſſarily ariſe out of the common ſea Chart: but other errors alſo which might be auoyded, if they firſt turned into degrees, thoſe diſtances of Longitude which they haue truly knowne, and then followed the Longitudes and latitudes of places.

Error in ſhewing the diſtances of places in the common ſea Chart.

5 In ſhewing the diſtances of places, there is as great error committed, as in any of the former. For example: If you imagine 2 ſhips to bee vnder the æquinoctial 100 leagues aſunder, and that each of them

them, should sayle from thence due North or South vnder his Meridian, vntill they come to the parallel of 60 degrees latitude: they should bee there but onely 50 leagues distant, because at that parallel the Meridians are distant but halfe so much one from another, as they were at the æquinoctial as it may most manifestly appeare by the globe: and yet the Chart will shew, that those two shippes haue the felfe same distance of 100 leagues, being vnder the parallel of 60 deg. which they had before, when they were vnder the æquinoctiall line.

Error in keeping alwaies the same point of the Compasse.

6 There is yet another error remaining (though all the former were auoyded) which ariseth hereof, because that by the direction of the Compasse they bend, and turne the shippe, in such sort, that they constraine it alwayes to make the same angles with the Meridian. As when they saile from Vshent to Cape Raso, both lying vnder the same parallel, they guide the ship in such sorte, that it maketh alwaies right angles with the Meridian, and so holding on their course due West, they keepe themselues alwaies vnder the same parallel; whereas notwithstanding, there is a more certaine course, whereby they may goe from one place to another without that losse of way, which they must needs make that keepe themselues alwaies vnder the same parallel.

There is moreouer another commoditie in this kinde of sailing, that we may finde euery day by a more certaine accompt what way wee haue made, and know in what place we are.

But this way is not to bee defined by any of the lesser circles, but by a great Circle which is to bee drawne

drawne by thoſe two places: and the arke of that great Circle conteined betwixt the ſame places is leſſe then the arke of the parallel which lieth betweene them, as may be concluded by an euident and neceſſary reaſon out of the principles of Geometrie: much like as a ſtreight line is ſhorter then a crooked, both being extended betweene the ſame pricks. Therefore this commoditie is alſo hereunto adioyned, that in ſayling by a great Circle, the way is more ſhort, and compendious. But he that entreth into this courſe of ſayling, muſt know, that he muſt often change the point of the Compaſſe whereupon he guideth the ſhip, becauſe of the variable, and inconſtant inæqualitie of the angles, which that great Circle maketh with euery new Meridian. Of which angles the inuention indeede (by the Chart eſpecially) is very ſubtile, and conſiſteth herein (to wit) in knowing how much ſuch kinde of angles doe decreaſe, or increaſe as the ſhip goeth forwards. And he that ſo ſhapeth his courſe, goeth the ſtreight and neereſt way. Otherwiſe it cannot be that a man ſhould keepe a ſtreight courſe, if he ſhall continually follow one and the ſame point, or line of the Compaſſe, (except hee ſaile vnder a Meridian, or vnder the æquinoctiall line:) but hee muſt chaunge the point of the Compaſſe ſo often as that ſtreight courſe ſhall ſenſibly require.

And therefore it cannot bee by any meanes that the Mariners, when they goe perpetually towards the ſame part of the world, keeping the ſame angle of poſition in reſpect of the Meridian, or the ſame

point

point of the Compaſſe; ſhould goe the ſhorteſt and neareſt way.

This kind of ſayling vnder a great Circle, is of eſpeciall vſe in our northerne Nauigations, for the diſcouery of the northeaſt or northweſt paſſage: which as it may moſt eaſily be performed by help of an hydrographicall globe, with the heliſphæricall lines drawne thereupon: ſo for them, that liſt not be troubled with the comberſom carriage and charge of the globe, it may be done (in a manner) with no leſſe facilitie by a nauticall planiſphære, made after the proiection of *Gemma Friſius* his aſtrolabe, whereof more hereafter when God ſhall giue leiſure.

The expreſſing of the rumbes by right lines defended: which ſome hold for erroneous.

There be ſome alſo that hold it for erroneous, that the rumbes in the mariners Chart ſhould be expreſſed by right lines, and conſequently that the meridians ſhould be parallels, or æquidiſtant euery where; which becauſe it is but barely affirmed, and the contrarie may bee prooued, as well as that each rumbe except the rumbe of North and South maketh æquall angles with euery meridian: wee hold it not onely as true, but alſo as moſt meete & commodious for the Mariners common vſe, that the meridians in the ſea Chart ſhould bee euery where æquidiſtant each from other, and conſequently that the rumbes ſhould be ſtreight lines for theſe two cauſes.

Firſt becauſe the rumbes or points of the Compaſſe may ſo moſt eaſily bee drawne in the nauticall Planiſphære, onely by a ſtreight ruler. For ſeeing that any one and the ſame rumbe (ſauing onely the rumbe of North and South, which is all one with the

the Meridian) maketh alwaies æquall angles with euery meridian, without either ſenſible, numerable, or mẽſurable, though not without intelligible error (for indeede thoſe angles are leſſe and leſſe as they come nearer to the pole, much like as the angle of a little ſemicircle is leſſe then the angle of a greater ſemicircle) all the rumbes muſt needes bee ſtreight lines, if the meridians be æquidiſtant and right lines by the 27 and 28 prop. 1. *Euclid.*

Secondly the reſpectiue ſituation of any place to other in the Chart (which they commonly call the lying of bearing of one place from another according to the points of the Compaſſe) may moſt eaſily be knowne by the nautical Planiſphære with right lined rumbes and æquidiſtant meridians. For that rumbe from which both places are æquidiſtant ſheweth how thoſe two places lye one from another.

And for theſe two cauſes of ſo great facility, both in the making, and vſing of the mariners Chart with æquidiſtant meridians, and ſtreight-lined rumbes, it ought to be preferred before any other inſtrument heretofore publiſhed to that end for the common vſe of the mariner, at ſea eſpecially. And though the globe be cõmended by ſome as moſt abſolute and perfect for all courſes and climates whatſoeuer: yet for the chargeablenes thereof, troubleſome carriage, ſtowage and tædious vſage for the moſt part in nauigation, following any other courſe ſaue Eaſt or Weſt, North or South: it will for the moſt part bee found vnmeete and comberſome, and nothing ſo fit and readie for the mariners common vſe at ſea as the nauticall planiſphære truely made.

Chap. II.

How the former errors may be auoyded.

THeſe errors notwithſtanding they haue beene much complained of by diuers, as namely by *Martine Corteſe* in his third booke, and ſecond chapter of the Art of Nauigation, but ſpecially by *Petrus Nonius* in his ſecond booke of Geometrical obſeruations, rules, and inſtruments: And although *Gerardus Mercator* in his vniuerſal Mappe of the world ſeemeth to correct them, by making the diſtances of the parallels greater and greater towards the poles: yet none of them teacheth any certaine way how to amend ſuch groſſe faults, whereby the Mariner may bee deceiued many times an whole point of the Compaſſe, yea ſometimes two or three points and more, in iudging by his ordinarie Chart how one place beareth from another: eſpecially if he ſaile far northwards, or ſouthwards, whereby we may eaſily geſſe, how indirect a courſe he ſhall make to come to the deſired hauen, that ſhall follow ſo falſe and erroneous direction with great danger (at the leaſt) many times to loſe ſhip, goods, liues and all.

The fountaine of all the errors aforeſaid (the laſt onely excepted) is in the very foundation and groundworke of the Mariners Chart, that is, in the firſt Geometricall lineaments thereof: namely, becauſe the meridians are not rightly diuided, (the diuiſions being euery where æquall:) nor the parallels rightly

rightly drawne (hauing in all places the ſame diſtances each from other that the meridians haue at the æquinoctial:) Whereas the ſpaces betwixt the parallels ſhould increaſe more and more as you goe from the æquinoctial towards either of the poles, which *Martin Corteſe* alſo noteth in his 3 booke and 2 chapter of the Art of Nauigation. But he omitteth that wherein all the difficultie lieth, that is, how much, or in what proportion thoſe ſpaces ſhould increaſe. Which, that it may the better bee perceiued, I think it not vnmeete firſt to ſhew by what kind of proiection (or extenſion rather) the nauticall planiſphære may not vnfitly bee conceiued to bee geometrically made, after this manner.

Suppoſe a ſphæricall ſuperficies with meridians, parallels, rumbes, and the whole hydrographicall deſcription drawne thereupon, to bee inſcribed into a concaue cylinder, their axes agreeing in one.

Let this ſphericall ſuperficies ſwel like a bladder, (whiles it is in blowing) æqually alwayes in euerie part thereof (that is, as much in longitude as in latitude) till it apply, and ioyne it ſelfe (round about, and all alongſt alſo towardes either pole) vnto the concaue ſuperficies of the cylinder: each parallel vpon this ſphæricall ſuperficies increaſing ſucceſſiuely from the æquinoctiall towardes either pole, vntill it come to bee of æquall diameter with the cylinder, and conſequently the meridians ſtil widening themſelues, til they come to bee ſo far diſtant euery where each from other as they are at the æquinoctiall. Thus it may moſt eaſily be vnderſtood, how a ſphæricall ſuperficies may (by extenſion) be made a cylindricall,

lindricall, and conſequently a plaine parallelogram ſuperficies; becauſe the ſuperficies of a cylinder is nothing elſe but a plaine parallelogramme wownd about two æquall æquidiſtant circles that haue one common axtree perpendicular vpon the centers of them both, and the peripheries of each of them æquall to the length of the parallelogramme as the diſtance betwixt thoſe circles, or height of the cylinder is æquall to the breadth thereof. So as the nauticall planiſphære may be defined to be nothing elſe but a parallelogramme made of the ſphæricall ſuperficies of an Hydrographicall globe inſcribed into a concaue cylinder, both their axes concurring in one; and the ſphæricall ſuperficies ſwelling in euery part equally in longitude and latitude, till euery one of the parallels thereupon be inſcribed into the cylinder (each parallel growing as great as the æquinoctial:) or till the whole ſphæricall ſuperficies, touch and apply it ſelfe euery where to the concauitie of the cylinder.

The definition of the nauticall planiſphære.

In this nauticall planiſphære thus conceiued to be made, all places muſt needes bee ſituate in the ſame longitudes, latitudes, and directions or courſes, and vpon the ſame meridians, parallels, and rumbes, that they were in the globe, becauſe that at euery poynt betweene the æquinoctiall and the pole, wee vnderſtand the ſphæricall ſuperficies whereof this planiſphære is conceiued to be made, to ſwell æqually as much in longitude as in latitude (til it ioyne it ſelfe vnto the concauitie of the cylinder, ſo as hereby no part thereof is any way diſtorted or diſplaced out of his true and naturall ſituation vpon his meridian, parallel,

rallel, or rumbe, but onely dilated and enlarged, the meridians alſo, parallels, and rumbes dilating and enlarging themſelues likewiſe, at euery point of latitude in the ſame proportion.

Now then let vs diligently conſider of the Geometricall lineaments, that is, the meridians, rumbs, and parallels of this imaginary nautical planiſphære, that we may in like manner expreſſe the ſame in the mariners Chart. For ſo vndoubtedly we ſhall haue therein a true hydrographicall deſcription of all places, in their longitudes, latitudes, and directions, or reſpectiue ſituations each from other according to the points of the Compaſſe in all things correſpondent to the globe, without either ſenſible, or explicable error.

Firſt therefore in this planiſphære, becauſe the parallels are euery where æquall each to other (for euery one of them is æquall to the æquinoctiall or circumference of the circumſcribing cylinder) the meridians alſo muſt needs be parallel and ſtreight lines: and conſequently the rumbs (making æquall angles with euery meridian) muſt likewiſe be ſtreight lines. 27. Prop. 1. Euclid 17.

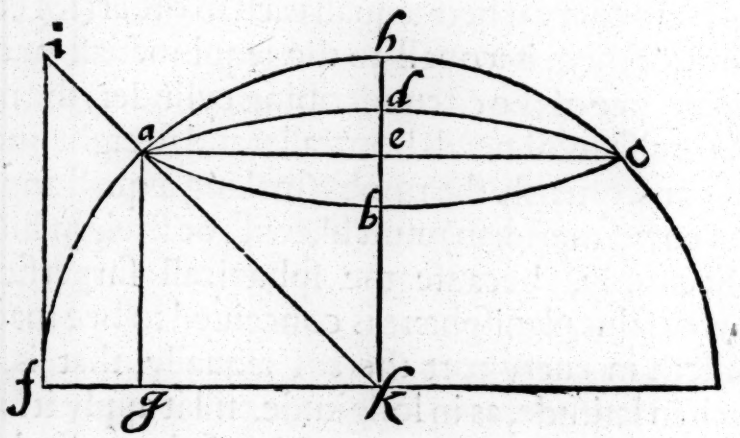
Secondly, becauſe the ſphæricall ſurperficies whereof this planiſphære is conceiued to bee made, ſwelleth in euery part thereof æqually, that is, as much in latitude, as in longitude, till it apply it ſelfe round about, to the concauitie of the cylinder: therefore at euery point of latitude in this planiſphære, a part of the meridian keepeth the ſame proportion to the like part of the parallel, that the like partes of the meridian, and parallel haue each to other in the globe, without any explicable error.

Now

Now becauſe like partes of wholes keepe the ſame proportion that their wholes haue, therefore the like parts of any parallel and meridian of the globe, haue the ſame proportion that the ſame parallel and meridian haue.

For example ſake, as the meridian is double to the parallel of 60 degrees, ſo a degree of the meridian is double to a degree of that parallel, or a minute to a minute &c. and what proportion the parallel hath to the meridian, the ſame proportion haue their diameters and ſemidiameters each to other. 26.18.*c*.2.*e*.15 *Rami*.

But the ſine of the complement of the parallels latitude, or diſtance from the æquinoctiall, is the ſemidiameter of the parallel;



As here you ſee, *a e* the ſine of *a h* the complement of *a f* the latitude or diſtance of the parallel *a b c d*, from the æquinoctial, is the ſemidiameter of the ſame parallel *a b c d*.

And as the ſemidiameter of the meridian (or the whole

whole ſine) is to the ſemidiameter of the parallel, ſo is the Secans, or Hypotenuſa of the parallels latitude (or of the parallels diſtance from the æquinoctial) to the ſemidiameter of the meridian, or to the whole ſine; as *f k* (that is) *a k*, to *a c* (that is) *g k*; ſo is *i k*, to *k f*.

Therefore in this nautical planiſphære, the ſemidiameter of each parallel being equal to the ſemidiameter of the æquinoctial (that is) to the whole ſine; the parts of the meridian at euery point of latitude muſt needs increaſe with the ſame proportion wherwith the Secantes of the arke, conteyned betweene thoſe points of latitude and the æquinoctial doe increaſe.

Now then we haue an eaſie way laid open for the making of a table (by helpe of the Canon of Triangles) whereby the meridians of the Mariners Chart may moſt eaſily and truly be diuided into parts, in due proportion from the æquinoctial towards either pole.

For (ſuppoſing each diſtance of each point of latitude, or of each parallel from other, to conteine ſo many parts as the Secans of the latitude of each point or parallel conteineth) by perpetuall addition of the Secantes anſwerable to the latitudes of each point or parallel vnto the ſumme compounded of all the former ſecantes, beginning with the ſecans of the firſt parallels latitude, and thereto adding the ſecans of the ſecond parallels latitude, and to the ſumme of both theſe adioyning the ſecans of the third parallels latitude, and ſo forth in all the reſt, we may make a table which ſhall truly ſhew the ſections and points

of latitude in the meridians of the nautical planiſphęre: by which ſections, the parallels are to bee drawne.

As in the table following, we make the diſtance of each parallel from other, to be one minute: and we ſuppoſe the ſpace betweene any two parallels each next to other in the planiſphære to conteine ſo many parts as the ſecans anſwerable to the diſtance of the furtheſt of thoſe two parallels from the æquinoctial, and ſo by perpetual addition of the ſecans of each minute to the ſumme compounded of all the former ſecants, I make the whole table. As for example, the ſecans of one minute is 10,000,000. which alſo ſheweth the ſection of one minute of the meridian from the æquinoctiall in the nauticall planiſphære. Whereunto adde the ſecans of 2. minutes, that is 10,000,002, the ſumme is 20,000,002. which ſheweth the ſection of the ſecond minute of the meridian from the æquinoctial, in the planiſphære: to this ſumme adde the ſecans of 3. minutes, which is 10,000,004, the ſumme will be 30,000,006. which ſheweth the ſection of the third minute of the meridian from the æquinoctial: and ſo forth in all the reſt: ſauing that in this table we haue of purpoſe omitted in euery ſecans the 3 firſt ciphers next the right hand: not only for the eaſier, but alſo for the truer making of the table, becauſe that indeed, at euery point of latitude, a minute of the meridian in this nauticall planiſphære, hath ſomewhat leſſe proportion to a minute of the parallel adioyning towards the æquinoctial, then the ſecans of that parallels latitude hath to the whole ſine. But in this table it

was

was thought ſufficient to vſe ſuch exactnes as that thereby (in drawing the lineaments of the nautical planiſphære) ſenſible error might be auoided. He that liſteth to be more preciſe may make the like table to decades or tennes of ſeconds out of *Ioachimus Rhæticus* his *Canon magnus trianguloꝝ.* Notwithſtanding the Geometriciã that deſireth exact trueth, cannot be ſo ſatisfied neither, for whoſe ſake and further ſatisfaction, I thought good to adioyne alſo this Geometrical conceit of diuiding a meridian of the nautical planiſphære.

Let the æquinoctial and a meridian be drawne vpon a Globe: Let the meridian (diuided into degrees, minutes, ſeconds, &c.) roule vpon a ſtreight line beginning at the æquinoctial, the Globe ſwelling in the meane time in ſuch ſort that the ſemidiameter thereof may be alwaies æqual to the ſecans of the angle, or arch conteined betweene the æquinoctial and ſemidiameter inſiſting at right angles vpon the foreſaid ſtreight line: The degrees, minutes, ſeconds &c. of the meridiã, noted in the ſtreight line, as they come to touch the ſame, are the diuiſions of the meridian in the nautical planiſphære. And this conceit of diuiding the meridian of the nautical planiſphære may ſatisfie the curious exactnes of the Geometrician: but for mechanical vſe, the table before mentioned (which heere now followeth) may ſuffice.

This Table (ſeruing principally for the true diuiding of the meridians of the Sea Chart, in ſuch ſort that in any part thereof, a minute of the meridian, ſhall haue the ſame proportion to a minute of the

parallel thereto adioyning that it hath in the globe) may not vnfitly be called, *A Table of Latitudes.*

For as in Geographie, the latitude of a place is nothing els but the ſhorteſt diſtance thereof from the æquinoctial line, meaſured vpon the conuexitie of the earth or ſea in degrees and minutes; and therefore Tables containing ſuch diſtances are ordinarily called tables of latitudes: So this Table, ſhewing the diſtance of euery minute of a meridian in the Sea Chart from the æquinoctiall line thereof towards the North or South, in ſuch equal parts whereof one minute of the æquinoctial is ſuppoſed to containe 10,000, may with like reaſon, by a certaine analogie, and reſemblance it holdeth with the foreſaid tables, be very well called, *A Table of Latitudes of euery minute of a meridian of the Sea Chart, in ſuch parts whereof each minute of the æquinoctial containeth* 10,000.

This Table is diuided into three columnes; wherof the firſt containeth, in the head thereof the degrees, and in the reſt of that columne, minutes of a meridian of the nauticall planiſphære, beginning at the æquinoctial line. In the ſecond columne are placed equal parts of the ſame meridian, beginning likewiſe to be numbred from the æquinoctial (of which parts each minute of the æquinoctial is ſuppoſed to containe 10,000) and ſheweth how many of theſe parts each minute of latitude in the Sea Chart muſt be diſtant from the æquinoctiall. The third columne ſheweth the differences of the numbers ſet downe in the ſecond columne.

The vſe hereof followeth after this Table.

0 Degr.			0 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	00,000		30	300,000	
1	10,000	10,000	31	310,000	10,000
2	20,000	10,000	32	320,000	10,000
3	30,000	10,000	33	330,000	10,000
4	40,000	10,000	34	340,000	10,000
5	50,000	10,000	35	350,000	10,000
6	60,000	10,000	36	360,000	10,000
7	70,000	10,000	37	370,000	10,000
8	80,000	10,000	38	380,000	10,000
9	90,000	10,000	39	390,000	10,000
10	100,000	10,000	40	400,000	10,000
11	110,000	10,000	41	410,000	10,000
12	120,000	10,000	42	420,000	10,000
13	130,000	10,000	43	430,000	10,000
14	140,000	10,000	44	440,000	10,000
15	150,000	10,000	45	450,000	10,000
16	160,000	10,000	46	460,000	10,000
17	170,000	10,000	47	470,000	10,000
18	180,000	10,000	48	480,000	10,000
19	190,000	10,000	49	490,001	10,001
20	200,000	10,000	50	500,002	10,001
21	210,000	10,000	51	510,003	10,001
22	220,000	10,000	52	520,004	10,001
23	230,000	10,000	53	530,005	10,001
24	240,000	10,000	54	540,006	10,001
25	250,000	10,000	55	550,007	10,001
26	260,000	10,000	56	560,008	10,001
27	270,000	10,000	57	570,009	10,001
28	280,000	10,000	58	580,010	10,001
29	290,000	10,000	59	590,011	10,001
30	300,000		60	600,012	10,001

I Degr.			I Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	600,012		30	900,070	
		10,001			10,003
1	610,013		31	910,073	
		10,001			10,003
2	620,014		32	920,076	
		10,001			10,003
3	630,015		33	930,079	
		10,001			10,003
4	640,016		34	940,082	
		10,001			10,003
5	650,017		35	950,085	
		10,001			10,003
6	660,018		36	960,088	
		10,001			10,003
7	670,019		37	970,091	
		10,001			10,004
8	680,020		38	980,095	
		10,002			10,004
9	690,022		39	990,099	
		10,002			10,004
10	700,024		40	1,000,103	
		10,002			10,004
11	710,026		41	1,010,107	
		10,002			10,004
12	720,028		42	1,020,111	
		10,002			10,004
13	730,030		43	1,030,115	
		10,002			10,004
14	740,032		44	1,040,119	
		10,002			10,004
15	750,034		45	1,050,123	
		10,002			10,004
16	760,036		46	1,060,127	
		10,002			10,004
17	770,038		47	1,070,131	
		10,002			10,004
18	780,040		48	1,080,135	
		10,002			10,005
19	790,042		49	1,090,140	
		10,002			10,005
20	800,044		50	1,100,145	
		10,002			10,005
21	810,046		51	1,110,150	
		10,002			10,005
22	820,048		52	1,120,155	
		10,002			10,005
23	830,050		53	1,130,160	
		10,062			10,005
24	840,052		54	1,140,165	
		10,003			10,005
25	850,055		55	1,150,170	
		10,003			10,005
26	860,058		56	1,160,175	
		10,003			10,005
27	870,061		57	1,170,180	
		10,003			10,005
28	880,064		58	1,180,185	
		10,003			10,005
29	890,067		59	1,190,190	
		10,003			10,006
30	900,070		60	1,200,196	

2 Degr.			2 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	1,200,196		30	1,500,416	
		10,006			10,009
1	1,210,202	10,006	31	1,510,425	10,009
2	1,220,208	10,006	32	1,520,434	10,009
3	1,230,214		33	1,530,443	
		10,006			10,010
4	1,240,220	10,006	34	1,540,453	10,010
5	1,250,226	10,006	35	1,550,463	10,010
6	1,260,232		36	1,560,473	
		10,006			10,010
7	1,270,238	10,006	37	1,570,483	10,010
8	1,280,244	10,007	38	1,580,493	10,010
9	1,290,251		39	1,590,503	
		10,007			10,010
10	1,300,258	10,007	40	1,600,513	10,010
11	1,310,265	10,007	41	1,610,523	10,011
12	1,320,272		42	1,620,534	
		10,007			10,011
13	1,330,279	10,007	43	1,630,545	10,011
14	1,340,286	10,007	44	1,640,556	10,011
15	1,350,293		45	1,650,567	
		10,007			10,011
16	1,360,300	10,007	46	1,660,578	10,011
17	1,370,307	10,008	47	1,670,589	10,011
18	1,380,315		48	1,680,600	
		10,008			10,012
19	1,390,323	10,008	49	1,690,612	10,012
20	1,400,331	10,008	50	1,700,624	10,012
21	1,410,339		51	1,710,636	
		10,008			10,012
22	1,420,347	10,008	52	1,720,648	10,012
23	1,430,355	10,008	53	1,730,660	10,012
24	1,440,363		54	1,740,672	
		10,008			10,012
25	1,450,371	10,009	55	1,750,684	10,013
26	1,460,380	10,009	56	1,760,697	10,013
27	1,470,389		57	1,770,710	
		10,009			10,013
28	1,480,398	10,009	58	1,780,723	10,013
29	1,490,407	10,009	59	1,790,736	10,013
30	1,500,416		60	1,800,749	

3 Degr. Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	1,800,749	10,013
1	1,810,762	10,014
2	1,820,776	10,014
3	1,830,790	10,014
4	1,840,804	10,014
5	1,850,818	10,014
6	1,860,832	10,014
7	1,870,846	10,014
8	1,888,860	10,015
9	1,890,875	10,015
10	1,900,890	10,015
11	1,910,905	10,015
12	1,920,920	10,015
13	1,930,935	10,015
14	1,940,950	10,016
15	1,950,966	10,016
16	1,960,982	10,016
17	1,970,998	10,016
18	1,981,014	10,016
19	1,991,030	10,016
20	2,001,046	10,017
21	2,011,063	10,017
22	2,021,080	10,017
23	2,031,097	10,017
24	2,041,114	10,017
25	2,051,131	10,017
26	2,061,148	10,018
27	2,071,166	10,018
28	2,081,184	10,018
29	2,091,202	10,018
30	2,101,220	

3 Degr. Min.	Equal parts of a meridian, &c.	Difference of equal parts.
30	2,101,220	10,018
31	2,111,238	10,019
32	2,121,257	10,019
33	2,131,276	10,019
34	2,141,295	10,019
35	2,151,314	10,019
36	2,161,333	10,019
37	2,171,352	10,020
38	2,181,372	10,020
39	2,191,392	10,020
40	2,201,412	10,020
41	2,211,432	10,020
42	2,221,452	10,021
43	2,231,473	10,021
44	2,241,494	10,021
45	2,251,515	10,021
46	2,261,536	30,021
47	2,271,557	10,022
48	2,281,579	10,022
49	2,291,601	10,022
50	2,301,623	10,022
51	2,311,645	10,022
52	2,321,667	10,023
53	2,331,690	10,023
54	2,341,713	10,023
55	2,351,736	10,023
56	2,361,759	10,023
57	2,371,782	10,024
58	2,381,806	10,024
59	2,391,830	10,024
60	2,401,854	

4 Degr.			4 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	2,401,854	10,024	30	2,702,671	10,031
1	2,411,878	10,024	31	2,712,702	10,031
2	2,421,902	10,025	32	2,722,733	10,031
3	2,431,927	10,025	33	2,732,764	10,031
4	2,441,952	10,025	34	2,742,795	10,032
5	2,451,977	10,025	35	2,752,827	10,032
6	2,462,002	10,025	36	2,762,859	10,032
7	2,472,027	10,026	37	2,772,891	10,032
8	2,482,053	10,026	38	2,782,923	10,033
9	2,492,079	10,026	39	2,792,956	10,033
10	2,502,105	10,026	40	2,802,989	10,033
11	2,512,131	10,026	41	2,813,022	10,033
12	2,522,157	10,027	42	2,823,055	10,033
13	2,532,184	10,027	43	2,833,088	10,034
14	2,542,211	10,027	44	2,843,122	10,034
15	2,552,238	10,027	45	2,853,156	10,034
16	2,562,265	10,028	46	2,863,190	10,034
17	2,572,293	10,028	47	2,873,224	10,035
18	2,582,321	10,028	48	2,883,259	10,035
19	2,592,349	10,028	49	2,893,294	10,035
20	2,602,377	10,028	50	2,903,329	10,035
21	2,612,405	10,029	51	2,913,364	10,036
22	2,622,434	10,029	52	2,923,400	10,036
23	2,632,463	10,029	53	2,933,436	10,036
24	2,642,492	10,029	54	2,943,472	10,036
25	2,652,521	10,030	55	2,953,508	10,037
26	2,662,551	10,030	56	2,963,545	10,037
27	2,672,581	10,030	57	2,973,582	10,037
28	2,682,611	10,030	58	2,983,619	10,037
29	2,692,641	10,030	59	2,993,656	10,038
30	2,702,671		60	3,003,694	

5 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	3,003,694	
1	3,013,732	10,038
2	3,023,770	10,038
3	3,033,808	10,038
4	3,043,847	10,039
5	3,053,886	10,039
6	3,063,925	10,039
7	3,073,965	10,040
8	3,084,005	10,040
9	3,094,045	10,040
10	3,104,085	10,040
11	3,114,126	10,041
12	3,124,167	10,041
13	3,134,208	10,041
14	3,144,249	10,041
15	3,154,291	10,042
16	3,164,333	10,042
17	3,174,375	10,042
18	3,184,417	10,042
19	3,194,460	10,043
20	3,204,503	10,043
21	3,214,546	10,043
22	3,224,590	10,044
23	3,234,634	10,044
24	3,244,678	10,044
25	3,254,722	10,044
26	3,264,767	10,045
27	3,274,812	10,045
28	3,284,857	10,045
29	3,294,902	10,046
30	3,304,948	

5 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.
30	3,304,948	
31	3,314,994	10,046
32	3,325,040	10,046
33	3,335,087	10,047
34	3,345,134	10,047
35	3,355,181	10,047
36	3,365,228	10,047
37	3,375,276	10,048
38	3,385,324	10,048
39	3,395,372	10,048
40	3,405,421	10,049
41	3,415,470	10,049
42	3,425,519	10,049
43	3,435,568	10,049
44	3,445,618	10,050
45	3,455,668	10,050
46	3,465,718	10,050
47	3,475,769	10,051
48	3,485,820	10,051
49	3,495,871	10,051
50	3,505,923	10,052
51	3,515,975	10,052
52	3,526,027	10,052
53	3,536,079	10,053
54	3,546,132	10,053
55	3,556,185	10,053
56	3,566,238	10,054
57	3,576,292	10,054
58	3,586,346	10,054
59	3,596,400	10,055
60	3,606,455	

6 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	3,606,455	10,055
1	3,616,510	10,055
2	3,626,565	10,056
3	3,636,621	10,056
4	3,646,677	10,056
5	3,656,733	10,056
6	3,666,789	10,057
7	3,676,846	10,057
8	3,686,903	10,057
9	3,696,960	10,058
10	3,707,018	10,058
11	3,717,076	10,058
12	3,727,134	10,059
13	3,737,193	10,059
14	3,747,252	10,059
15	3,757,311	10,060
16	3,767,371	10,060
17	3,777,431	10,060
18	3,787,491	10,061
19	3,797,552	10,061
20	3,807,613	10,061
21	3,817,674	10,062
22	3,827,736	10,062
23	3,837,798	10,062
24	3,847,860	10,063
25	3,857,923	10,063
26	3,867,986	10,063
27	3,878,049	10,064
28	3,888,113	10,064
29	3,898,177	10,064
30	3,908,241	

6 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.
30	3,908,241	10,065
31	3,918,306	10,065
32	3,928,371	10,065
33	3,938,436	10,066
34	3,948,502	10,066
35	3,958,568	10,066
36	3,968,634	10,067
37	3,978,701	10,067
38	3,988,768	10,067
39	3,998,835	10,068
40	4,008,903	10,068
41	4,018,971	10,068
42	4,029,039	10,069
43	4,039,108	10,069
44	4,049,177	10,069
45	4,059,246	10,070
46	4,069,316	10,070
47	4,079,386	10,070
48	4,089,456	10,071
49	4,099,527	10,071
50	4,109,598	10,071
51	4,119,669	10,072
52	4,129,741	10,072
53	4,139,813	10,072
54	4,149,885	10,073
55	4,159,958	10,073
56	4,170,031	10,074
57	4,180,105	10,074
58	4,190,179	10,074
59	4,200,253	10,075
60	4,210,328	

7 Degr.			7 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	4,210,328		30	4,512,737	
		10,075			10,086
1	4,220,403		31	4,122,823	
		10,075			10,087
2	4,230,478		32	4,532,910	
		10,076			10,087
3	4,240,554		33	4,542,997	
		10,076			10,087
4	4,250,630		34	4,553,084	
		10,076			10,088
5	4,260,706		35	4,563,172	
		10,077			10,088
6	4,270,783		36	4,573,260	
		10,077			10,089
7	4,280,860		37	4,583,349	
		10,078			10,089
8	4,290,938		38	4,593,438	
		10,078			10,089
9	4,301,016		39	4,603,527	
		10,078			10,090
10	4,311,094		40	4,613,617	
		10,079			10,090
11	4,321,173		41	4,623,707	
		10,079			10,090
12	4,331,252		42	4,633,797	
		10,079			10,091
13	4,341,331		43	4,643,888	
		10,080			10,091
14	4,351,411		44	4,653,979	
		10,080			10,092
15	4,361,491		45	4,664,071	
		10,080			10,092
16	4,371,571		46	4,674,136	
		10,081			10,092
17	4,381,652		47	4,684,228	
		10,081			10,093
18	4,391,733		48	4,694,321	
		10,082			10,093
19	4,401,815		49	4,704,414	
		10,082			10,094
20	4,411,897		50	4,714,508	
		10,082			10,094
21	4,421,979		51	4,724,602	
		10,083			10,095
22	4,432,062		52	4,734,697	
		10,083			10,095
23	4,442,145		53	4,744,792	
		10,083			10,095
24	4,452,228		54	4,754,887	
		10,084			10,096
25	4,462,312		55	4,764,983	
		10,084			10,096
26	4,472,396		56	4,775,079	
		10,085			10,097
27	4,482,481		57	4,785,176	
		10,085			10,097
28	4,492,566		58	4,795,273	
		10,085			10,097
29	4,502,651		59	4,805,370	
		10,086			10,098
30	4,512,737		60	4,815,468	

8 Degr.			8 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	4,815,468		30	5,118,608	
		10,098			10,111
1	4,825,566		31	5,128,719	
		10,099			10,111
2	4,835,665		32	5,138,830	
		10,099			10,112
3	4,845,764		33	5,148,942	
		10,099			10,112
4	4,855,863		34	5,159,054	
		10,100			10,113
5	4,865,963		35	5,169,167	
		10,100			10,113
6	4,876,063		36	5,179,280	
		10,101			10,114
7	4,886,164		37	5,189,394	
		10,101			10,114
8	4,896,265		38	5,199,508	
		10,102			10,115
9	4,906,367		39	5,209,623	
		10,102			10,115
10	4,916,469		40	5,219,738	
		10,102			10,115
11	4,926,571		41	5,229,853	
		10,103			10,116
12	4,936,674		42	5,239,969	
		10,103			10,116
13	4,946,777		43	5,250,085	
		10,104			10,117
14	4,956,881		44	5,260,203	
		10,104			10,117
15	4,966,985		45	5,270,319	
		10,104			10,118
16	4,977,089		46	5,280,437	
		10,105			10,118
17	4,987,194		47	5,290,555	
		10,105			10,119
18	4,997,299		48	5,300,674	
		10,106			10,119
19	5,007,405		49	5,310,793	
		10,106			10,120
20	5,017,511		50	5,320,913	
		10,107			10,120
21	5,027,618		51	5,331,033	
		10,107			10,120
22	5,037,725		52	5,341,153	
		10,108			10,121
23	5,047,833		53	5,351,274	
		10,108			10,121
24	5,057,941		54	5,361,395	
		10,108			10,122
25	5,068,049		55	5,371,517	
		10,109			10,122
26	5,078,158		56	5,381,639	
		10,119			10,123
27	5,088,277		57	5,391,762	
		10,110			10,123
28	5,098,387		58	5,401,885	
		10,110			10,124
29	5,108,497		59	5,412,009	
		10,111			10,124
30	5,118,608		60	5,422,133	

9 Degr.			9 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	5,422,133	10,125	30	5,726,080	10,139
1	5,432,258	10,125	31	5,736,219	10,140
2	5,442,383	10,126	32	5,746,359	10,140
3	5,452,509	10,126	33	5,756,499	10,141
4	5,462,635	10,126	34	5,766,640	10,141
5	5,472,761	10,127	35	5,776,781	10,142
6	5,482,888	10,127	36	5,786,923	10,142
7	5,493,015	10,128	37	5,797,065	10,143
8	5,503,143	10,128	38	5,807,208	10,143
9	5,513,271	10,129	39	5,817,351	10,144
10	5,523,400	10,129	40	5,827,495	10,144
11	5,533,529	10,130	41	5,837,639	10,145
12	5,543,659	10,130	42	5,847,784	10,145
13	5,553,789	10,131	43	5,857,929	10,146
14	5,563,920	10,131	44	5,868,075	10,146
15	5,574,051	10,132	45	5,878,221	10,147
16	5,584,183	10,132	46	5,888,368	10,147
17	5,594,315	10,133	47	5,898,515	10,148
18	5,604,448	10,133	48	5,908,663	10,148
19	5,614,581	10,134	49	5,918,811	10,149
20	5,624,715	10,134	50	5,928,960	10,149
21	5,634,849	10,135	51	5,939,109	10,150
22	5,644,984	10,135	52	5,949,259	10,150
23	5,655,119	10,136	53	5,959,409	10,151
24	5,665,255	10,136	54	5,969,560	10,151
25	5,675,391	10,137	55	5,979,711	10,152
26	5,685,528	10,137	56	5,989,863	10,152
27	5,695,665	10,138	57	6,000,015	10,153
28	5,705,803	10,138	58	6,010,168	10,153
29	5,715,941	10,139	59	6,020,321	10,154
30	5,726,080		60	6,030,475	

10 Degr.			10 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	6,030,475		30	6,335,335	
		10,154			10,170
1	6,040,629		31	6,345,505	
		10,155			10,171
2	6,050,784		32	6,355,676	
		10,155			10,171
3	6,060,939		33	6,365,847	
		10,156			10,172
4	6,071,095		34	6,376,019	
		10,156			10,173
5	6,081,251		35	6,386,192	
		10,157			10,173
6	6,091,408		36	6,396,365	
		10,157			10,174
7	6,101,565		37	6,406,539	
		10,158			10,174
8	6,111,723		38	6,416,713	
		10,158			10,175
9	6,121,881		39	6,426,888	
		10,159			10,175
10	6,132,040		40	6,437,063	
		10,160			10,176
11	6,142,200		41	6,447,239	
		10,160			10,176
12	6,152,360		42	6,457,415	
		10,161			10,177
13	6,162,521		43	6,467,592	
		10,161			10,178
14	6,172,682		44	6,477,770	
		10,162			10,178
15	6,182,844		45	6,487,948	
		10,162			10,179
16	6,193,006		46	6,498,127	
		30,163			10,179
17	6,203,169		47	6,508,306	
		10,163			10,180
18	6,213,332		48	6,518,486	
		10,164			10,180
19	6,223,496		49	6,528,666	
		10,165			10,181
20	6,233,661		50	6,538,847	
		10,165			10,182
21	6,243,826		51	6,549,029	
		10,165			10,182
22	6,253,991		52	6,559,211	
		10,166			10,183
23	6,264,157		53	6,569,394	
		10,167			10,183
24	6,274,324		54	6,579,577	
		10,167			10,184
25	6,284,491		55	6,589,761	
		10,168			10,184
26	6,294,659		56	6,599,945	
		10,168			10,185
27	6,304,827		57	6,610,130	
		10,169			10,186
28	6,314,996		58	6,620,316	
		10,169			10,186
29	6,325,165		59	6,630,502	
		10,170			10,187
30	6,335,335		60	6,640,689	

11 Degr.			11 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	6,640,689	10,187	30	6,946,561	10,205
1	6,650,876	10,188	31	6,956,766	10,206
2	6,661,064	10,188	32	6,966,972	10,206
3	6,671,252	10,189	33	6,977,178	10,207
4	6,681,441	10,190	34	6,987,385	10,207
5	6,691,631	10,190	35	6,997,592	10,208
6	6,701,821	10,191	36	7,007,800	10,209
7	6,712,012	10,191	37	7,018,009	10,209
8	6,722,203	10,192	38	7,028,218	10,210
9	6,732,395	10,192	39	7,038,428	10,210
10	6,742,587	10,193	40	7,048,638	10,211
11	6,752,780	10,194	41	7,058,849	10,212
12	6,762,974	10,194	42	7,069,061	10,212
13	6,773,168	10,195	43	7,079,273	10,213
14	6,783,363	10,195	44	7,089,486	10,214
15	6,793,558	10,196	45	7,099,700	10,214
16	6,803,754	10,197	46	7,109,914	10,215
17	6,813,951	10,197	47	7,120,129	10,215
18	6,824,148	10,198	48	7,130,344	10,216
19	6,834,346	10,198	49	7,140,560	10,217
20	6,844,544	10,199	50	7,150,777	10,217
21	6,854,743	10,200	51	7,160,994	10,218
22	6,864,943	10,200	52	7,171,212	10,219
23	6,875,143	10,201	53	7,181,431	10,219
24	6,885,344	10,201	54	7,191,650	10,220
25	6,895,545	10,202	55	7,201,870	10,220
26	6,905,747	10,203	56	7,212,090	10,221
27	6,915,950	10,203	57	7,222,311	10,222
28	6,926,153	10,204	58	7,232,533	10,222
29	6,936,357	10,204	59	7,242,755	10,223
30	6,946,561		60	7,252,978	

12 Degr.			12 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	7,252,968		30	7,559,953	
		10,224			10,243
1	7,263,192		31	7,570,196	
		10,224			10,244
2	7,273,416		32	7,580,440	
		10,225			10,244
3	7,283,641		33	7,590,684	
		10,225			10,245
4	7,293,866		34	7,600,929	
		10,226			10,246
5	7,304,092		35	7,611,175	
		10,227			10,246
6	7,314,319		36	7,621,421	
		10,227			10,247
7	7,324,546		37	7,631,668	
		10,228			10,248
8	7,334,774		38	7,641,916	
		10,229			10,248
9	7,345,003		39	7,652,164	
		10,229			10,249
10	7,355,232		40	7,662,413	
		10,230			10,250
11	7,365,462		41	7,672,663	
		10,231			10,250
12	7,375,693		42	7,682,913	
		10,231			10,251
13	7,385,924		43	7,693,164	
		10,232			10,252
14	7,396,156		44	7,703,416	
		10,232			10,252
15	7,406,388		45	7,713,668	
		10,233			10,253
16	7,416,621		46	7,723,921	
		10,234			10,254
17	7,426,855		47	7,734,175	
		10,234			10,254
18	7,437,089		48	7,744,429	
		10,235			10,255
19	7,447,324		49	7,754,684	
		10,236			10,256
20	7,457,560		50	7,764,940	
		10,236			10,256
21	7,467,796		51	7,775,196	
		10,237			10,257
22	7,478,033		52	7,785,453	
		10,238			10,258
23	7,488,271		53	7,795,711	
		10,238			10,258
24	7,498,509		54	7,805,969	
		10,239			10,259
25	7,508,748		55	7,816,228	
		10,240			10,260
26	7,518,988		56	7,826,488	
		10,240			10,260
27	7,529,228		57	7,836,748	
		10,241			10,261
28	7,539,469		58	7,847,009	
		10,242			10,262
29	7,549,711		59	7,857,271	
		10,242			10,263
30	7,559,953		60	7,867,534	

13 Degr.			13 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	7,867,534		30	8,175,736	
		10,263			10,284
1	7,877,797	10,264	31	8,186,020	10,285
2	7,888,061	10,265	32	8,196,305	10,286
3	7,898,326		33	8,206,591	
		10,265			10,287
4	7,908,591	10,266	34	8,216,878	10,287
5	7,918,857	10,267	35	8,227,165	10,288
6	7,929,124		36	8,237,453	
		10,267			10,289
7	7,939,391	10,268	37	8,247,742	10,289
8	7,949,659	10,269	38	8,258,031	10,290
9	7,959,928		39	8,268,321	
		10,269			10,291
10	7,970,197	10,270	40	8,278,612	10,292
11	7,980,467	10,271	41	8,288,904	10,292
12	7,990,738		42	8,299,196	
		10,272			10,293
13	8,001,010	10,272	43	8,309,489	10,294
14	8,011,282	10,273	44	8,319,783	10,295
15	8,021,555		45	8,330,078	
		10,274			10,295
16	8,031,829	10,274	46	8,340,373	10,296
17	8,042,103	10,275	47	8,350,669	10,297
18	8,052,378		48	8,360,966	
		10,276			10,297
19	8,062,654	10,277	49	8,371,263	10,298
20	8,072,931	10,277	50	8,381,561	10,299
21	8,083,208		51	8,391,860	
		10,278			10,300
22	8,093,486	10,279	52	8,402,160	10,300
23	8,103,765	10,279	53	8,412,460	10,301
24	8,114,044		54	8,422,761	
		10,280			10,302
25	8,124,324	10,281	55	8,433,063	10,303
26	8,134,605	10,282	56	8,443,366	10,303
27	8,144,887		57	8,453,669	
		10,282			10,304
28	8,155,169	10,283	58	8,463,973	10,305
29	8,165,452	10,284	59	8,474,278	10,306
30	8,175,736		60	8,484,584	

14 Degr.			14 Degr.		
Min	Equal parts of a meridian. &c.	Difference of equal parts.	Min	Equal parts of a meridian. &c.	Difference of equal parts.
0	8,484,584		30	8,794,105	
		10,306			10,329
1	8,494,890		31	8,804,434	
		10,307			10,330
2	8,505,197		32	8,814,764	
		10,308			10,331
3	8,515,505		33	8,825,095	
		10,309			10,332
4	8,525,814		34	8,835,427	
		10,309			10,332
5	8,536,123		35	8,845,759	
		10,310			10,333
6	8,546,433		36	8,856,092	
		10,311			10,334
7	8,556,744		37	8,866,426	
		10,312			10,335
8	8,567,056		38	8,876,761	
		10,312			10,336
9	8,577,368		39	8,887,097	
		10,313			10,336
10	8,587,681		40	8,897,433	
		10,314			10,337
11	8,597,995		41	8,907,770	
		10,315			10,338
12	8,608,310		42	8,918,108	
		10,315			10,339
13	8,618,625		43	8,928,447	
		10,316			10,339
14	8,628,941		44	8,938,786	
		10,317			10,340
15	8,639,258		45	8,949,126	
		10,318			10,341
16	8,649,576		46	8,959,467	
		10,318			10,342
17	8,659,894		47	8,969,809	
		10,319			10,343
18	8,670,213		48	8,980,152	
		10,320			10,343
19	8,680,533		49	8,990,495	
		10,321			10,344
20	8,690,854		50	9,000,839	
		10,322			10,345
21	8,701,176		51	9,011,184	
		10,322			10,346
22	8,711,498		52	9,021,530	
		10,323			10,347
23	8,721,821		53	9,031,877	
		10,324			10,347
24	8,732,145		54	9,042,224	
		10,325			10,348
25	8,742,470		55	9,052,572	
		10,325			10,349
26	8,752,795		56	9,062,921	
		10,326			10,350
27	8,763,121		57	9,073,271	
		10,327			10,351
28	8,773,448		58	9,083,622	
		10,328			10,351
29	8,783,776		59	9,093,973	
		10,329			10,352
30	8,794,105		60	9,104,325	

15 Degr.			15 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian &c.	Difference of equal parts.
0	9,104,325		30	9,415,272	
1	9,114,678	10,353	31	9,425,650	10,378
2	9,125,032	10,354	32	9,436,029	10,379
3	9,135,387	10,355	33	9,446,408	10,379
4	9,145,742	10,355	34	9,456,788	10,380
5	9,156,098	10,356	35	9,467,169	10,381
6	9,166,455	10,357	36	9,477,551	10,382
7	9,176,813	10,358	37	9,487,934	10,383
8	9,187,172	10,359	38	9,498,318	10,384
9	9,197,532	10,360	39	9,508,702	10,384
10	9,207,892	10,360	40	9,519,087	10,385
11	9,218,253	10,361	41	9,529,473	10,386
12	9,228,615	10,362	42	9,539,860	10,387
13	9,238,978	10,363	43	9,550,248	10,388
14	9,249,342	10,364	44	9,560,637	10,389
15	9,259,706	10,364	45	9,571,027	10,390
16	9,270,071	10,365	46	9,581,417	10,390
17	9,280,437	10,366	47	9,591,808	10,391
18	9,290,804	10,367	48	9,602,200	10,392
19	9,301,172	10,368	49	9,612,593	10,393
20	9,311,541	10,369	50	9,622,987	10,394
21	9,321,910	10,369	51	9,633,382	10,395
22	9,332,280	10,370	52	9,643,778	10,396
23	9,342,651	10,371	53	9,654,174	10,396
24	9,353,023	10,372	54	9,664,571	10,397
25	9,363,396	10,373	55	9,674,969	10,398
26	9,373,770	10,374	56	9,685,368	10,399
27	9,384,144	10,374	57	9,695,768	10,400
28	9,394,519	10,375	58	9,706,169	10,401
29	9,404,895	10,376	59	9,716,571	10,402
30	9,415,272	10,377	60	9,726,973	10,402

16 Degr.			16 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	9,726,973	10,403	30	10,039,456	10,430
1	9,737,376	10,404	31	10,049,886	10,431
2	9,747,780	10,405	32	10,060,317	10,432
3	9,758,185	10,406	33	10,070,749	10,433
4	9,768,591	10,407	34	10,081,182	10,433
5	9,778,998	10,408	35	10,091,615	10,434
6	9,789,406	10,409	36	10,102,049	10,435
7	9,799,815	10,409	37	10,112,484	10,436
8	9,810,224	10,410	38	10,122,920	10,437
9	9,820,634	10,411	39	10,133,357	10,438
10	9,831,045	10,412	40	10,143,795	10,439
11	9,841,457	10,413	41	10,154,234	10,440
12	9,851,870	10,414	42	10,164,674	10,441
13	9,862,284	10,415	43	10,175,115	10,442
14	9,872,699	10,416	44	10,185,557	10,443
15	9,883,115	10,417	45	10,196,000	10,443
16	9,893,532	10,417	46	10,206,443	10,444
17	9,903,949	10,418	47	10,216,887	10,445
18	9,914,367	10,419	48	10,227,332	10,446
19	9,924,786	10,420	49	10,237,778	10,447
20	9,935,206	10,421	50	10,248,225	10,448
21	9,945,627	10,422	51	10,258,673	10,449
22	9,956,049	10,423	52	10,269,122	10,450
23	9,966,472	10,424	53	10,279,572	10,451
24	9,976,896	10,425	54	10,290,023	10,452
25	9,987,321	10,425	55	10,300,475	10,453
26	9,997,746	10,426	56	10,310,928	10,454
27	10,008,172	10,427	57	10,321,382	10,455
28	10,018,599	10,428	58	10,331,837	10,455
29	10,029,027	10,429	59	10,342,292	10,456
30	10,039,456		60	10,352,748	

17 Degr.		
Min.	Equal parts of a meridian. &c.	Difference of qual parts.
0	10,352,748	10,457
1	10,363,205	10,458
2	10,373,663	10,459
3	10,384,122	10,460
4	10,394,582	10,461
5	10,405,043	10,462
6	10,415,505	10,463
7	10,425,968	10,464
8	10,436,432	10,465
9	10,446,897	10,466
10	10,457,363	10,467
11	10,467,820	10,468
12	10,478,298	10,469
13	10,488,767	10,470
14	10,499,237	10,470
15	10,509,707	10,471
16	10,520,178	10,472
17	10,530 650	10,473
18	10,541,123	10,474
19	10,551,597	10,475
20	10,562,072	10,476
21	10,572,548	10,477
22	10,583,025	10,478
23	10,593,503	10,479
24	10,603,982	10,480
25	10,614,462	10,481
26	10,624,943	10,482
27	10,635,425	10,483
28	10,645,908	10,484
29	10,656,392	10,485
30	10,666,877	

17 Degr.		
Min.	Equal parts of a meridian &c.	Difference of qual parts.
30	10,666,877	10,486
31	10,677,363	10,487
32	10,687,850	10,488
33	10,698,338	10,489
34	10,708,827	10,490
35	10,719,317	10,491
36	10,729,808	10,492
37	10,740,300	10,493
38	10,750,792	10,493
39	10,761,286	10,494
40	10,771,780	10,495
41	10,782,275	10,496
42	10,792,771	10,497
43	10,803,268	10,498
44	10,813,766	10,499
45	10,824,265	10,500
46	10,834,765	10,501
47	10,845,266	10,502
48	10,855,768	10,503
49	10,866,271	10,504
50	10,876,775	10,505
51	10,887,280	10,506
52	10,897,786	10,507
53	10,908,293	10,508
54	10,918,801	10,509
55	10,929,310	10,510
56	10,939,820	10,511
57	10,950,331	10,512
58	10,960,843	10,513
59	10,971,356	10,514
60	10,981,870	

18 Degr.			18 Degr.		
Min.	Equal parts of a meridian. &c.	Difference of equal parts.	Min.	Equal parts of a meridian. &c.	Difference of equal parts.
0	10,981,870		30	11,297,753	
		10,515			10,545
1	10,992,383	10,516	31	11,308,298	10,546
2	11,002,899	10,517	32	11,318,844	10,548
3	11,013,416	10,518	33	11,329,392	10,549
4	11,023,934	10,519	34	11,339,941	10,550
5	11,034,453	10,520	35	11,350,491	10,551
6	11,044,973	10,521	36	11,361,042	10,552
7	11,055,494	10,522	37	11,371,594	10,553
8	11,066,016	10,523	38	11,382,147	10,554
9	11,076,539	10,524	39	11,392,701	10,555
10	11,087,063	10,525	40	11,403,256	10,556
11	11,097,588	10,526	41	11,413,812	10,557
12	11,108,114	10,527	42	11,424,369	10,558
13	11,118,641	10,528	43	11,434,927	10,559
14	11,129,169	10,529	44	11,445,486	10,560
15	11,139,698	10,530	45	11,456,046	10,561
16	11,150,228	10,531	46	11,466,607	10,562
17	11,160,759	10,532	47	11,477,169	10,563
18	11,171,291	10,533	48	11,487,732	10,564
19	11,181,824	10,534	49	11,498,296	10,565
20	11,192,358	10,535	50	11,508,861	10,566
21	11,202,893	10,536	51	11,519,427	10,567
22	11,213,429	10,537	52	11,529,994	10,568
23	11,223,966	10,538	53	11,540,562	10,569
24	11,234,504	10,539	54	11,551,131	10,570
25	11,245,043	10,540	55	11,561,701	10,571
26	11,255,583	10,541	56	11,572,272	10,573
27	11,266,124	10,542	57	11,582,845	10,574
28	11,276,666	10,543	58	11,593,419	10,575
29	11,287,209	10,544	59	11,603,994	10,576
30	11,297,753		60	11,614,570	

19 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	11,614,570	10,577
1	11,625,147	10,578
2	11,635,725	10,579
3	11,646,304	10,580
4	11,656,884	10,581
5	11,667,465	10,582
6	11,678,047	10,583
7	11,688,630	10,584
8	11,699,214	10,585
9	11,709,799	10,586
10	11,720,385	10,587
11	11,730,972	10,588
12	11,741,560	10,590
13	11,752,150	10,591
14	11,762,741	10,592
15	11,773,333	10,593
16	11,783,926	10,594
17	11,794,520	10,595
18	11,805,115	10,596
19	11,815,711	10,597
20	11,826,308	10,598
21	11,836,906	10,599
22	11,847,505	10,600
23	11,858,105	10,601
24	11,868,706	10,603
25	11,879,309	10,604
26	11,889,913	10,605
27	11,900,518	10,606
28	11,911,124	10,607
29	11,921,731	10,608
30	11,932,339	

19 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.
30	11,932,339	10,609
31	11,942,948	10,610
32	11,953,558	10,611
33	11,964,169	10,612
34	11,974,781	10,613
35	11,985,394	10,615
36	11,996,009	10,616
37	12,006,625	10,617
38	12,017,242	10,618
39	12,027,860	10,619
40	12,038,479	10,620
41	12,049,099	10,621
42	12,059,720	10,622
43	12,070,342	10,623
44	12,080,965	10,625
45	12,091,590	10,626
46	12,102,216	10,627
47	12,112,843	10,628
48	12,123,471	10,629
49	12,134,100	10,630
50	12,144,730	10 631
51	12,155,361	10,632
52	12,165,993	10,633
53	12,176,636	10,635
54	12,187,261	10,636
55	12,197,897	10,637
56	12,208,534	10,638
57	12,219,172	10,639
58	12,229,811	10,640
59	12,240,451	10,641
60	12,251,292	

20 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	12,251,292	
		10,642
1	12,261,934	
		10,644
2	12,272,578	
		10,645
3	12,283,223	
		10,646
4	12,293,869	
		10,647
5	12,304,516	
		10,648
6	12,315,164	
		10,649
7	12,325,813	
		10,650
8	12,336,463	
		10,651
9	12,347,114	
		10,653
10	12,357,767	
		10,654
11	12,368,421	
		10,655
12	12,379,076	
		10,656
13	12,389,732	
		10,657
14	12,400,389	
		10,658
15	12,411,047	
		10,659
16	12,421,706	
		10,661
17	12,432,367	
		10,662
18	12,443,029	
		10,663
19	12,453,692	
		10,664
20	12,464,356	
		10,665
21	12,475,021	
		10,666
22	12,485,687	
		10,667
23	12,496,354	
		10,669
24	12,507,023	
		10,670
25	12,517,693	
		10,671
26	12,528,364	
		10,672
27	12,539,036	
		10,673
28	12,549,709	
		10,674
29	12,560,383	
		10,676
30	12,571,059	

20 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.
30	12,571,059	
		10,677
31	12,581,736	
		10,678
32	12,592,414	
		10,679
33	12,603,093	
		10,680
34	12,613,773	
		10,681
35	12,624,454	
		10,683
36	16,635,137	
		10,684
37	12,645,821	
		10,685
38	12,656,506	
		10,686
39	12,667,192	
		10,687
40	12,677,879	
		10,688
41	12,688,567	
		10,690
42	12,699,257	
		10,691
43	12,709,948	
		10,692
44	12,720,640	
		10,693
45	12,731,333	
		10,694
46	12,742,027	
		10,696
47	12,752,723	
		10,697
48	12,763,420	
		10,698
49	12,774,118	
		10,699
50	12,784,817	
		10,700
51	12,795,517	
		10,701
52	12,806,218	
		10,703
53	12.816.921	
		10,704
54	12,827,625	
		10,705
55	12,838,330	
		10,706
56	12,849,036	
		10,707
57	12,859,743	
		10,709
58	12,870,452	
		10,710
59	12,881,162	
		10,711
60	12,891,873	

21 Degr.			21 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	12,891,873	10,712	30	13,213,763	10,749
1	12,902,585	10,713	31	13,224,512	10,750
2	12,913,298	10,715	32	13,235,262	10,751
3	12,924,013	10,716	33	13,246,013	10,752
4	12,934,729	10,717	34	13,256,765	10,754
5	12,945,446	10,718	35	13,267,519	10,755
6	12,956,164	10,719	36	13,278,274	10,756
7	12,966,883	10,721	37	13,289,030	10,757
8	12,977,604	10,722	38	13,299,787	10,758
9	12,988,326	10,723	39	13,310,545	10,760
10	12,999,049	10,724	40	13,321,305	10,761
11	13,009,773	10,725	41	13,332,066	10,762
12	13,020,498	10,727	42	13,342,828	10,763
13	13,031,225	10,728	43	13,353,591	10,765
14	13,041,953	10,729	44	13,364,356	10,766
15	13,052,682	10,730	45	13,375,122	10,767
16	13,063,412	10,731	46	13,385,889	10,768
17	13,074,143	10,733	47	13,396,657	10,770
18	13,084,876	10,734	48	13,407,427	10,771
19	13,095,610	10,735	49	13,418,198	10,772
20	13,106,345	10,736	50	13,428,970	10,773
21	13,117,081	10,738	51	13,439,743	10,775
22	13,127,819	10,739	52	13,450,518	10,776
23	13,138,558	10,740	53	13,461,294	10,777
24	13,149,298	10,741	54	13,472,071	10,779
25	13,160,039	10,742	55	13,482,850	10,780
26	13,170,781	10,744	56	13,493,630	10,781
27	13,181,525	10,745	57	13,504,411	10,782
28	13,192,270	10,746	58	13,515,193	10,784
29	13,203,016	10,747	59	13,525,977	10,785
30	13,213,763		60	13,536,762	

22 Degr.			22 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	13,536,752	10,786	30	13,860,902	10,825
1	13,547,548	10,787	31	13,871,727	10,826
2	13,558,335	10,789	32	13,882,553	10,827
3	13,569,124	10,790	33	13,893,380	10,829
4	13,579,914	10,791	34	13,904,209	10,830
5	13,590,705	10,792	35	13,915,039	10,831
6	13,601,497	10,794	36	13,925,870	10,833
7	13,612,291	10,795	37	13,936,703	10,834
8	13,623,086	10,796	38	13,947,537	10,835
9	13,633,882	10,798	39	13,958,372	10,837
10	13,644,680	10,799	40	13,969,209	10,838
11	13,655,479	10,800	41	13,980,047	10,839
12	13,666,279	10,801	42	13,990,886	10,840
13	13,677,070	10,803	43	14,001,726	10,842
14	13,687,873	10,804	44	14,012,568	10,843
15	13,698,677	10,805	45	14,023,411	10,844
16	13,709,492	10,807	46	14,034,255	10,846
17	13,720,299	10,808	47	14,045,101	10,847
18	13,731,107	10,809	48	14,055,948	10,848
19	13,741,916	10,810	49	14,066,796	10,850
20	13,752,726	10,812	50	14,077,646	10,851
21	13,763,538	10,813	51	14,088,497	10,852
22	13,774,351	10,814	52	14,099,349	10,854
23	13,785,165	10,816	53	14,110,203	10,855
24	13,795,981	10,817	54	14,121,058	10,856
25	13,806,798	10,818	55	14,131,914	10,858
26	13,817,616	10,820	56	14,142,772	10,859
27	13,828,436	10,821	57	14,153,631	10,860
28	13,839,257	10,822	58	14,164,491	10,862
29	13,850,079	10,823	59	14,175,353	10,863
30	13,860,902		60	14,186,216	

23 Degr.			23 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	14,186,216	10,864	30	14,512,719	10,905
1	14,197,080	10,866	31	14,523,624	10,907
2	14,207,946	10,867	32	14,534,531	10,908
3	14,218,813	10,868	33	14,545,439	10,909
4	14,229,681	10,870	34	14,556,348	10,911
5	14,240,551	10,871	35	14,567,259	10,912
6	14,251,422	10,873	36	14,578,171	10,914
7	14,262,275	10,874	37	14,589,085	10,915
8	14,273,149	10,875	38	14,600,000	10,916
9	14,284,024	10,877	39	14,610,916	10,918
10	14,294,901	10,878	40	14,621,834	10,919
11	14,305,779	10,879	41	14,632,753	10,921
12	14,316,658	10,881	42	14,643,674	10,922
13	14,327,539	10,882	43	14,654,596	10,923
14	14,338,421	10,883	44	14,665,519	10,925
15	14,349,304	10,885	45	14,676,444	10,926
16	14,360,189	10,886	46	14,687,370	10,928
17	14,371,075	10,887	47	14,698,298	10,929
18	14,381,962	10,889	48	14,709,227	10,930
19	14,392,851	10,890	49	14,720,157	10,932
20	14,403,741	10,892	50	14,731,089	10,933
21	14,414,633	10,893	51	14,742,022	10,935
22	14,425,526	10,894	52	14,752,957	10,936
23	14,436,420	10,896	53	14,763,893	10,937
24	14,447,316	10,897	54	14,774,830	10,939
25	14,458,213	10,898	55	14,785,769	10,940
26	14,469,111	10,900	56	14,796,709	10,942
27	14,480,011	10,901	57	14,807,651	10,943
28	14,490,912	10,903	58	14,818,594	10,944
29	14,501,815	10,904	59	14,829,538	10,946
30	14,512,719		60	14,840,484	

24 Degr.			24 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	14,840,484		30	15,169,526	
		10,947			10,990
1	14,851,431		31	15,180,516	
		10,949			10,992
2	14,862,380		32	15,191,508	
		10,950			10,993
3	14,873,330		33	15,202,501	
		10,952			10,995
4	14,884,282		34	15,213,496	
		10,953			10,996
5	14,895,235		35	15,224,492	
		10,954			10,998
6	14,906,189		36	15,235,490	
		10,956			10,999
7	14,917,145		37	15,246,489	
		10,957			11,001
8	14,928,102		38	15,257,490	
		10,959			11,002
9	14,939,061		39	15,268,492	
		10,960			11,004
10	14,950,021		40	15,279,496	
		10,962			11,005
11	14,960,983		41	15,290,501	
		10,963			11,007
12	14,971,946		42	15,301,508	
		10,964			11,008
13	14,982,910		43	15,312,516	
		10,966			11,010
14	14,993,876		44	15,323,526	
		10,967			11,011
15	15,004,843		45	15,334,537	
		10,969			11,012
16	15,015,812		46	15,345,549	
		10,970			11,014
17	15,026,782		47	15,356,563	
		10,972			11,015
18	15,037,754		48	15,367,578	
		10,973			11,017
19	15,048,727		49	15,378,595	
		10,974			11,018
20	15,059,701		50	15,389,613	
		10,976			11,020
21	15,070,677		51	15,400,633	
		10,977			11,021
22	15,081,654		52	15,411,654	
		10,979			11,023
23	15,092,633		53	15,422,677	
		10,980			11,024
24	15,103,613		54	15,433,701	
		10,982			11,026
25	15,114,595		55	15,444,727	
		10,983			11,027
26	15,125,578		56	15,455,754	
		10,985			11,029
27	15,136,563		57	15,466,783	
		10,986			11,030
28	15,147,549		58	15,477,813	
		10,988			11,032
29	15,158,537		59	15,488,845	
		10,989			11,033
30	15,169,526		60	15,499,878	

25 Degr.			25 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	15,499,878	11,035	30	15,831,578	11,080
1	15,510,913	11,036	31	15,842,658	11,082
2	15,521,949	11,038	32	15,853,740	11,083
3	15,532,987	11,039	33	15,864,823	11,085
4	15,544,026	11,041	34	15,875,908	11,086
5	15,555,067	11,042	35	15,886,994	11,088
6	15,566,109	11,044	36	15,898,082	11,090
7	15,577,153	11,045	37	15,909,172	11,091
8	15,588,198	11,047	38	15,920,263	11,093
9	15,599,245	11,048	39	15,931,356	11,094
10	15,610,293	11,050	40	15,942,450	11,096
11	15,621,343	11,051	41	15,953,546	11,097
12	15,632,394	11,053	42	15,964,643	11,099
13	15,643,447	11,054	43	15,975,742	11,100
14	15,654,501	11,056	44	15,986,842	11,102
15	15,665,557	11,057	45	15,997,944	11,104
16	15,676,614	11,059	46	16,009,048	11,105
17	15,687,673	11,060	47	16,020,153	11,107
18	15,698,733	11,062	48	16,031,260	11,108
19	15,709,805	11,063	49	16,042,368	11,110
20	15,720,858	11,065	50	16,053,478	11,111
21	15,731,923	11,067	51	16,064,589	11,113
22	15,742,990	11,068	52	16,075,702	11,115
23	15,754,058	11,070	53	16,086,817	11,116
24	15,765,128	11,071	54	16,097,933	11,118
25	15,776,199	11,073	55	16,109,051	11,119
26	15,787,272	11,074	56	16,120,170	11,121
27	15,798,346	11,076	57	16,131,291	11,122
28	15,809,432	11,077	58	16,142,413	11,124
29	15,820,499	11,079	59	16,153,537	11,126
30	15,831,578		60	16,164,663	

26 Degr.			26 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	16,164,663		30	16,499,170	
		11,127			11,175
1	16,175,790		31	16,510,345	
		11,129			11,177
2	16,186,919		32	16,521,522	
		11,130			11,178
3	16,198,049		33	16,532,700	
		11,132			11,180
4	16,209,181		34	16,543,880	
		11,133			11,182
5	16,220,314		35	16,555,062	
		11,135			11,183
6	16,231,449		36	16,566,245	
		11,137			11,185
7	16,242,586		37	16,577,430	
		11,138			11,187
8	16,253,724		38	16,588,617	
		11,140			11,188
9	16,264,864		39	16,599,805	
		11,141			11,190
10	16,276,005		40	16,610,995	
		11,143			11,191
11	16,287,148		41	16,622,186	
		11,145			11,193
12	16,298,293		42	16,633,379	
		11,146			11,195
13	16,309,439		43	16,644,574	
		11,148			11,196
14	16,320,587		44	16,655,770	
		11,149			11,198
15	16,331,736		45	16,666,968	
		11,151			11,200
16	16,342,887		46	16,678,168	
		11,153			11,201
17	16,354,040		47	16,689,369	
		11,154			11,203
18	16,365,194		48	16,700,572	
		11,156			11,205
19	16,376,350		49	16,711,777	
		11,157			11,206
20	16,387,507		50	16,722,983	
		11,159			11,208
21	16,398,666		51	16,734,191	
		11,161			11,210
22	16,409,827		52	16,745,401	
		11,162			11,211
23	16,420,989		53	16,756,612	
		11,164			11,213
24	16,432,153		54	16,767,825	
		11,165			11,214
25	16,443,318		55	16,779,039	
		11,167			11,216
26	16,454,485		56	16,790,255	
		11,169			11,218
27	16,465,654		57	16,801,473	
		11,170			11,219
28	16,476,824		58	16,812,692	
		11,172			11,221
29	16,487,996		59	16,823,913	
		11,174			11,223
30	16,499,170		60	16,835,136	

27 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	16,835,136	11,224
1	16,846,360	11,226
2	16,857,586	11,228
3	16,868,814	11,229
4	16,880,043	11,231
5	16,891,274	11,233
6	16,902,507	11,234
7	16,913,741	11,236
8	16,924,977	11,238
9	16,936,215	11,239
10	16,947,454	11,241
11	16,958,695	11,243
12	16,969,938	11,245
13	16,981,183	11,246
14	16,992,429	11,248
15	17,003,677	11,250
16	17,014,927	11,251
17	17,026,178	11,253
18	17,037,431	11,255
19	17,048,686	11,256
20	17,059,942	11,258
21	17,071,200	11,260
22	17,082,460	11,261
23	17,093,721	11,263
24	17,104,964	11,265
25	17,116,229	11,267
26	17,127,496	11,268
27	17,138,764	11,270
28	17,150,034	11,272
29	17,161,306	11,273
30	17,172,579	

27 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.
30	17,172,579	11,275
31	17,183,854	11,277
32	17,195,131	11,278
33	17,206,409	11,280
34	17,217,689	11,282
35	17,228,971	11,284
36	17,240,255	11,285
37	17,251,540	11,287
38	17,262,827	11,289
39	17,274,116	11,290
40	17,285,406	11,292
41	17,296,698	11,294
42	17,307,992	11,296
43	17,319,288	11,297
44	17,330,585	11,299
45	17,341,884	11,301
46	17,353,185	11,303
47	17,364,488	11,304
48	17,375,792	11,306
49	17,387,098	11,308
50	17,398,406	11,309
51	17,409,715	11,311
52	17,421,026	11,313
53	17,432,339	11,315
54	17,443,654	11,316
55	17,454,970	11,318
56	17,466,288	11,320
57	17,477,608	11,322
58	17,488,930	11,323
59	17,500,253	11,325
60	17,511,578	

28 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	17,511,578	11,327
1	17,522,905	11,329
2	17,534,234	11,330
3	17,545,564	11,332
4	17,556,896	11,334
5	17,568,230	11,336
6	17,579,566	11,337
7	17,590,903	11,339
8	17,602,242	11,341
9	17,613,583	11,343
10	17,624,926	11,345
11	17,636,271	11,346
12	17,647,617	11,348
13	17,658,965	11,350
14	17,670,315	11,352
15	17,681,667	11,353
16	17,693,020	11,355
17	17,704,375	11,357
18	17,715,732	11,359
19	17,727,091	11,361
20	17,738,452	11,362
21	17,749,814	11,364
22	17,761,178	11,366
23	17,772,544	11,368
24	17,783,912	11,369
25	17,795,281	11,371
26	17,806,652	11,373
27	17,818,025	11,375
28	17,829,400	11,377
29	17,840,777	11,378
30	17,852,155	

28 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.
30	17,852,155	11,380
31	17,863,535	11,382
32	17,874,917	11,384
33	17,886,301	11,386
34	17,897,687	11,387
35	17,909,074	11,389
36	17,920,463	11,391
37	17,931,854	11,393
38	17,943,247	11,395
39	17,954,642	11,396
40	17,966,038	11,398
41	17,977,436	11,400
42	17,988,836	11,402
43	18,000,238	11,404
44	18,011,642	11,406
45	18,023,048	11,407
46	18,034,455	11,409
47	18,045,864	11,411
48	18,057,275	11,413
49	18,068,688	11,415
50	18,080,103	11,417
51	18,091,520	11,418
52	18,102,938	11,420
53	18,114,358	11,422
54	18,125,780	11,424
55	18,137,204	11,426
56	18,148,630	11,428
57	18,160,058	11,429
58	18,171,487	11,431
59	18,182,918	11,433
60	18,194,351	

29 Degr.			29 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	18,194,351		30	18,538,207	
		11,435			11,491
1	18,205,786		31	18,549,698	
		11,437			11,493
2	18,217,223		32	18,561,191	
		11,439			11,495
3	18,228,662		33	18,572,686	
		11,440			11,497
4	18,240,102		34	18,584,183	
		11,442			11,499
5	18,251,544		35	18,595,682	
		11,444			11,500
6	18,262,988		36	18,607,182	
		11,446			11,502
7	18,274,434		37	18,618,684	
		11,448			11,504
8	18,285,882		38	18,630,188	
		11,450			11,506
9	18,297,332		39	18,641,694	
		11,452			11,508
10	18,308,784		40	18,653,202	
		11,453			11,510
11	18,320,237		41	18,664,712	
		11,455			11,512
12	18,331,692		42	18,676,224	
		11,457			11,514
13	18,343,149		43	18,687,738	
		11,459			11,516
14	18,354,608		44	18,699,254	
		11,461			11,518
15	18,366,069		45	18,710,772	
		11,463			11,520
16	18,377,532		46	18,722,292	
		11,465			11,521
17	18,388,997		47	18,733,813	
		11,466			11,523
18	18,400,463		48	18,745,336	
		11,468			11,525
19	18,411,931		49	18,756,861	
		11,470			11,527
20	18,423,401		50	18,768,388	
		11,472			11,529
21	18,434,873		51	18,779,917	
		11,474			11,531
22	18,446,347		52	18,791,448	
		11,476			11,533
23	18,457,823		53	18,802,981	
		11,478			11,535
24	18,469,301		54	18,814,516	
		11,480			11,537
25	18,480,781		55	18,826,053	
		11,482			11,539
26	18,492,263		56	18,837,592	
		11,483			11,541
27	18,503,746		57	18,849,133	
		11,485			11,543
28	18,515,231		58	18,860,676	
		11,487			11,545
29	18,526,718		59	18,872,221	
		11,489			11,547
30	18,538,207		60	18,883,768	

30 Degr.			30 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	18,883,768		30	19,231,072	
		11,548			11,607
1	18,895,316		31	19,242,679	
		11,550			11,609
2	18,906,866		32	19,254,288	
		11,552			11,611
3	18,918,418		33	19,265,899	
		11,554			11,613
4	18,929,972		34	19,277,512	
		11,556			11,615
5	18,941,528		35	19,289,127	
		11,558			11,617
6	18,953,086		36	19,300,734	
		11,560			11,619
7	18,964,646		37	19,312,353	
		11,562			11,621
8	18,976,208		38	19,323,974	
		11,564			11,623
9	18,987,772		39	19,335,597	
		11,566			11,625
10	18,999,338		40	19,347,222	
		11,568			11,627
11	19,010,906		41	19,358,849	
		11,570			11,629
12	19,022,476		42	19,370,478	
		11,572			11,631
13	19,034,048		43	19,382,109	
		11,574			11,633
14	19,045,622		44	19,393,742	
		11,576			11,635
15	19,057,198		45	19,405,377	
		11,578			11,637
16	19,068,776		46	19,417,014	
		11,580			11,639
17	19,080,356		47	19,428,653	
		11,582			11,641
18	19,091,938		48	19,440,294	
		11,584			11,644
19	19,103,522		49	19,451,938	
		11,586			11,646
20	19,115,108		50	19,463,584	
		11,588			11,648
21	19,126,696		51	19,475,232	
		11,590			11,650
22	19,138,286		52	19,486,882	
		11,592			11,652
23	19,149,878		53	19,498,534	
		11,594			11,654
24	19,161,472		54	19,510,188	
		11,595			11,656
25	19,173,067		55	19,521,844	
		11,597			11,658
26	19,184,664		56	19,533,502	
		11,599			11,660
27	19,196,263		57	19,545,162	
		11,601			11,662
28	19,207,864		58	19,556,824	
		11,603			11,664
29	19,219,467		59	19,568,488	
		11,605			11,666
30	19,231,072		60	19,580,154	

31 Degr.			31 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	19,580,154		30	19,931,085	
		11,668			11,730
1	19,591,822		31	19,942,815	
		11,670			11,732
2	19,603,492		32	19,954,547	
		11,672			11,734
3	19,615,164		33	19,966,281	
		11,674			11,736
4	19,626,838		34	19,978,017	
		11,676			11,738
5	19,638,514		35	19,989,755	
		11,678			11,740
6	19,650,192		36	20,001,495	
		11,680			11,742
7	19,661,872		37	20,013,237	
		11,682			11,745
8	19,673,554		38	20,024,982	
		11,684			11,747
9	19,685,238		39	20,036,729	
		11,686			11,749
10	19,696,924		40	20,048,478	
		11,688			11,751
11	19,708,612		41	20,060,229	
		11,690			11,753
12	19,720,302		42	20,071,982	
		11,692			11,755
13	19,731,994		43	20,083,737	
		11,695			11,757
14	19,743,699		44	20,095,494	
		11,697			11,759
15	19,755,396		45	20,107,253	
		11,699			11,761
16	19,767,085		46	20,119,014	
		11,701			11,764
17	19,778,786		47	20,130,778	
		11,703			11,766
18	19,790,489		48	20,142,544	
		11,705			11,768
19	19,802,194		49	20,154,312	
		11,707			11,770
20	19,813,901		50	20,166,082	
		11,709			11,772
21	19,825,610		51	20,177,854	
		11,711			11,774
22	19,837,321		52	20,189,628	
		11,713			11,776
23	19,849,034		53	20,201,404	
		11,715			11,778
24	19,860,749		54	20,213,182	
		11,717			11,781
25	19,872,466		55	20,224,963	
		11,719			11,783
26	19,884,185		56	20,236,746	
		11,722			11,785
27	19,895,907		57	20,248,531	
		11,724			11,787
28	19,907,631		58	20,260,318	
		11,726			11,789
29	19,919,357		59	20,272,107	
		11,728			11,791
30	19,931,085		60	20,283,898	

32 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	20,283,898	11,793
1	20,295,691	11,796
2	20,307,487	11,798
3	20,319,285	11,800
4	20,331,085	11,802
5	20,342,887	11,804
6	20,354,691	11,806
7	20,366,497	11,808
8	20,378,305	11,811
9	20,390,116	11,813
10	20,401,929	11,815
11	20,413,744	11,817
12	20,425,561	11,819
13	20,437,380	11,821
14	20,449,201	11,824
15	20,461,025	11,826
16	20,472,851	11,828
17	20,484,679	11,830
18	20,496,509	11,832
19	20,508,341	11,835
20	20,520,176	11,837
21	20,532,013	11,839
22	20,543,852	11,841
23	20,555,693	11,843
24	20,567,536	11,845
25	20,579,381	11,848
26	20,591,229	11,850
27	20,603,079	11,852
28	20,614,931	11,854
29	20,626,785	11,856
30	20,638,641	

32 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.
30	20,638,641	11,859
31	20,650,500	11,861
32	20,662,361	11,863
33	20,674,224	11,865
34	20,686,089	11,867
35	20,697,956	11,870
36	20,709,826	11,872
37	20,721,702	11,874
38	20,733,576	11,876
39	20,745,452	11,878
40	20,757,330	11,881
41	20,769,211	11,883
42	20,781,094	11,885
43	20,792,979	11,887
44	20,804,866	11,890
45	20,816,756	11,892
46	20,828,648	11,894
47	20,840,542	11,896
48	20,852,438	11,898
49	20,864,336	11,901
50	20,876,237	11,903
51	20,888,140	11,905
52	20,900,045	11,907
53	20,911,952	11,910
54	20,923,862	11,912
55	20,935,774	11,914
56	20,947,688	11,916
57	20,959,604	11,919
58	20,971,523	11,921
59	20,983,444	11,923
60	20,995,367	

31 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	19,580,154	11,668
1	19,591,822	11,670
2	19,603,492	11,672
3	19,615,164	11,674
4	19,626,838	11,676
5	19,638,514	11,678
6	19,650,192	11,680
7	19,661,872	11,682
8	19,673,554	11,684
9	19,685,238	11,686
10	19,696,924	11,688
11	19,708,612	11,690
12	19,720,302	11,692
13	19,731,994	11,695
14	19,743,699	11,697
15	19,755,396	11,699
16	19,767,085	11,701
17	19,778,786	11,703
18	19,790,489	11,705
19	19,802,194	11,707
20	19,813,901	11,709
21	19,825,610	11,711
22	19,837,321	11,713
23	19,849,034	11,715
24	19,860,749	11,717
25	19,872,466	11,719
26	19,884,185	11,722
27	19,895,907	11,724
28	19,907,631	11,726
29	19,919,357	11,728
30	19,931,085	

31 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.
30	19,931,085	11,730
31	19,942,815	11,732
32	19,954,547	11,734
33	19,966,281	11,736
34	19,978,017	11,738
35	19,989,755	11,740
36	20,001,495	11,742
37	20,013,237	11,745
38	20,024,982	11,747
39	20,036,729	11,749
40	20,048,478	11,751
41	20,060,229	11,753
42	20,071,982	11,755
43	20,083,737	11,757
44	20,095,494	11,759
45	20,107,253	11,761
46	20,119,014	11,764
47	20,130,778	11,766
48	20,142,544	11,768
49	20,154,312	11,770
50	20,166,082	11,772
51	20,177,854	11,774
52	20,189,628	11,776
53	20,201,404	11,778
54	20,213,182	11,781
55	20,224,963	11,783
56	20,236,746	11,785
57	20,248,531	11,787
58	20,260,318	11,789
59	20,272,107	11,791
60	20,283,898	

32 Degr.			32 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	20,283,898		30	20,638,641	
		11,793			11,859
1	20,295,691		31	20,650,500	
		11,796			11,861
2	20,307,487		32	20,662,361	
		11,798			11,863
3	20,319,285		33	20,674,224	
		11,800			11,865
4	20,331,085		34	20,686,089	
		11,802			11,867
5	20,342,887		35	20,697,956	
		11,804			11,870
6	20,354,691		36	20,709,826	
		11,806			11,872
7	20,366,497		37	20,721,702	
		11,808			11,874
8	20,378,305		38	20,733,576	
		11,811			11,876
9	20,390,116		39	20,745,452	
		11,813			11,878
10	20,401,929		40	20,757,330	
		11,815			11,881
11	20,413,744		41	20,769,211	
		11,817			11,883
12	20,425,561		42	20,781,094	
		11,819			11,885
13	20,437,380		43	20,792,979	
		11,821			11,887
14	20,449,201		44	20,804,866	
		11,824			11,890
15	20,461,025		45	20,816,756	
		11,826			11,892
16	20,472,851		46	20,828,648	
		11,828			11,894
17	20,484,679		47	20,840,542	
		11,830			11,896
18	20,496,509		48	20,852,438	
		11,832			11,898
19	20,508,341		49	20,864,336	
		11,835			11,901
20	20,520,176		50	20,876,237	
		11,837			11,903
21	20,532,013		51	20,888,140	
		11,839			11,905
22	20,543,852		52	20,900,045	
		11,841			11,907
23	20,555,693		53	20,911,952	
		11,843			11,910
24	20,567,536		54	20,923,862	
		11,845			11,912
25	20,579,381		55	20,935,774	
		11,848			11,914
26	20,591,229		56	20,947,688	
		11,850			11,916
27	20,603,079		57	20,959,604	
		11,852			11,919
28	20,614,931		58	20,971,523	
		11,854			11,921
29	20,626,785		59	20,983,444	
		11,856			11,923
30	20,638,641		60	20,995,367	

33 Degr.			33 Degr.		
Min.	Equal parts of a meridian. &c.	Difference of equal parts.	Min.	Equal parts of a meridian. &c.	Difference of equal parts.
0	20,995,367	11,925	30	21,354,117	11,994
1	21,007,292	11,928	31	21,366,111	11,996
2	21,019,220	11,930	32	21,378,107	11,998
3	21,031,150	11,932	33	21,390,105	12,001
4	21,043,082	11,934	34	21,402,106	12,003
5	21,055,016	11,937	35	21,414,109	12,005
6	21,066,953	11,939	36	21,426,114	12,008
7	21,078,892	11,941	37	21,438,122	12,010
8	21,090,833	11,943	38	21,450,132	12,012
9	21,102,776	11,946	39	21,462,144	12,015
10	21,114,722	11,948	40	21,474,159	12,017
11	21,126,670	11,950	41	21,486,176	12,019
12	21,138,620	11,953	42	21,498,195	12,022
13	21,150,573	11,955	43	21,510,217	12,024
14	21,162,528	11,957	44	21,522,241	12,026
15	21,174,485	11,959	45	21,534,267	12,029
16	21,186,444	11,962	46	21,546,296	12,031
17	21,198,406	11,964	47	21,558,327	12,033
18	21,210,370	11,966	48	21,570,360	12,036
19	21,222,336	11,969	49	21,582,396	12,038
20	21,234,305	11,971	50	21,594,434	12,040
21	21,246,276	11,973	51	21,606,474	12,043
22	21,258,249	11,975	52	21,618,517	12,045
23	21,270,224	11,978	53	21,630,562	12,048
24	21,282,202	11,980	54	21,642,610	12,050
25	21,294,182	11,982	55	21,654,660	12,052
26	21,306,164	11,985	56	21,666,712	12,055
27	21,318,149	11,987	57	21,678,767	12,057
28	21,330,136	11,989	58	21,690,824	12,059
29	21,342,125	11,992	59	21,702,883	12,062
30	21,354,117		60	21,714,945	

34 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	21,714,945	12,064
1	21,727,009	12,066
2	21,739,075	12,069
3	21,751,144	12,071
4	21,763,215	12,074
5	21,775,289	12,076
6	21,787,365	12,078
7	21,799,443	12,081
8	21,811,524	12,083
9	21,823,607	12,085
10	21,835,692	12,088
11	21,847,780	12,090
12	21,859,870	12,093
13	21,871,963	12,095
14	21,884,058	12,097
15	21,896,155	12,100
16	21,908,255	12,102
17	21,920,357	12,105
18	21,932,462	12,107
19	21,944,569	12,109
20	21,956,678	12,112
21	21,968,790	12,114
22	21,980,904	12,117
23	21,993,021	12,119
24	22,005,140	12,121
25	22,017,261	12,124
26	22,029,385	12,126
27	22,041,511	12,129
28	22,053,640	12,131
29	22,065,771	12,134
30	22,077,905	

34 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.
30	22,077,905	12,136
31	22,090,041	12,138
32	22,102,179	12,141
33	22,114,320	12,143
34	22,126,463	12,146
35	22,138,609	12,148
36	22,150,757	12,150
37	22,162,907	12,153
38	22,175,060	12,155
39	22,187,215	12,158
40	22,199,373	12,160
41	22,211,533	12,163
42	22,223,696	12,165
43	22,235,861	12,168
44	22,248,029	12,170
45	22,260,199	12,173
46	22,272,372	12,175
47	22,284,547	12,178
48	22,296,725	12,180
49	22,308,905	12,182
50	22,321,087	12,185
51	22,333,272	12,187
52	22,345,459	12,190
53	22,357,649	12,192
54	22,369,841	12,195
55	22,382,036	12,197
56	22,394,233	12,200
57	22,406,433	12,202
58	22,418,635	12,205
59	22,430,840	12,207
60	22,443,047	

35 Degr.			35 Degr.		
Min.	Equal parts of a meridian. &c.	Difference of equal parts.	Min.	Equal parts of a meridian. &c.	Difference of equal parts.
0	22,443,047		30	22,810,531	
		12,210			12,285
1	22,455,257	12,212	31	22,822,816	12,288
2	22,467,469	12,215	32	22,835,104	12,290
3	22,479,684	12,217	33	22,847,394	12,293
4	22,491,901	12,220	34	22,859,687	12,296
5	22,504,221	12,222	35	22,871,983	12,298
6	22,516,443	12,225	36	22,884,281	12,301
7	22,528,668	12,227	37	22,896,582	12,303
8	22,540,895	12,230	38	22,908,885	12,306
9	22,553,125	12,232	39	22,921,191	12,308
10	22,565,357	12,235	40	22,933,499	12,311
11	22,577,592	12,237	41	22,945,810	12,314
12	22,589,829	12,240	42	22,958,124	12,316
13	22,602,069	12,242	43	22,970,440	12,319
14	22,614,311	12,245	44	22,982,759	12,321
15	22,626,556	12,247	45	22,995,080	12,324
16	22,638,803	12,250	46	23,007,404	12,326
17	22,651,053	12,252	47	23,019,730	12,329
18	22,663,305	12,255	48	23,032,059	12,332
19	22,675,560	12,257	49	23,044,391	12,334
20	22,687,817	12,260	50	23,056,725	12,337
21	22,700,077	12,262	51	23,069,062	12,339
22	22,712,339	12,265	52	23,081,401	12,342
23	22,724,604	12,268	53	23,093,743	12,345
24	22,736,872	12,270	54	23,106,088	12,347
25	22,749,142	12,273	55	23,118,435	12,350
26	22,761,415	12,275	56	23,130,785	12,352
27	22,773,690	12,278	57	23,143,137	12,355
28	22,785,968	12,280	58	23,155,492	12,358
29	22,798,248	12,283	59	23,167,850	12,360
30	22,810,531		60	23,180,210	

36 Degr.			36 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	23,180,210		30	23,552,344	
		12,363			12,442
1	23,192,573		31	23,564,786	
		12,365			12,445
2	23,204,938		32	23,577,231	
		12,368			12,448
3	23,217,306		33	23,589,679	
		12,371			12,450
4	23,229,677		34	23,602,129	
		12,373			12,453
5	23,242,050		35	23,614,582	
		12,376			12,456
6	23,254,426		36	23,627,038	
		12,379			12,458
7	23,266,805		37	23,639,496	
		12,381			12,461
8	23,279,186		38	23,651,957	
		12,384			12,464
9	23,291,570		39	23,664,421	
		12,386			12,466
10	23,303,956		40	23,676,887	
		12,389			12,469
11	23,316,345		41	23,689,356	
		12,392			12,472
12	23,328,737		42	23,701,828	
		12,394			12,475
13	23,341,133		43	23,714,303	
		12,397			12,477
14	23,353,530		44	23,726,780	
		12,400			12,480
15	23,365,930		45	23,739,260	
		12,402			12,483
16	23,378,332		46	23,751,743	
		12,405			12,485
17	23,390,837		47	23,764,228	
		12,408			12,488
18	23,403,245		48	23,776,716	
		12,410			12,491
19	23,415,655		49	23,789,207	
		12,413			12,494
20	23,428,068		50	23,801,701	
		12,416			12,496
21	23,440,484		51	23,814,197	
		12,418			12,499
22	23,452,902		52	23,826,696	
		12,421			12,502
23	23,465,323		53	23,839,198	
		12,423			12.504
24	23,477,746		54	23,851,702	
		12,426			12,507
25	23,490,172		55	23,864,209	
		12,429			12,510
26	23,502,601		56	23,876,719	
		12,432			12,513
27	23,515,033		57	23,889,232	
		12,434			12,515
28	23,527,467		58	23,901,747	
		12,437			12,518
29	23,539,904		59	23,914,265	
		12,440			12,521
30	23,552,344		60	23,926,786	

37 Degr.			37 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	23,926,786		30	24,303,699	
		12,524			12,607
1	23,939,310		31	24,316,306	
		12,526			12,610
2	23,951,836		32	24,328,916	
		12,529			12,613
3	23,964,365		33	24,341,529	
		12,532			12,615
4	23,976,897		34	24,354,144	
		12,535			12,618
5	23,989,432		35	24,366,762	
		12,537			12,621
6	24,001,969		36	24,379,383	
		12,540			12,624
7	24,014,509		37	24,392,007	
		12,543			12,627
8	24,027,052		38	24,404,634	
		12,546			12,630
9	24,039,598		39	24,417,264	
		12,548			12,632
10	24,052,146		40	24,429,896	
		12,551			12,635
11	24,064,697		41	24,442,531	
		12,554			12,638
12	24,077,251		42	24,455,169	
		12,557			12,641
13	24,089,808		43	24,467,810	
		12,560			12,644
14	24,102,368		44	24,480,454	
		12,562			12,647
15	24,114,930		45	24,493,101	
		12,565			12,650
16	24,127,495		46	24,505,751	
		12,568			12,652
17	24,140,063		47	24,518,403	
		12,571			12,655
18	24,152,634		48	24,531,058	
		12,573			12,658
19	24,165,207		49	24,543,716	
		12,576			12,661
20	24,177,783		50	24,556,377	
		12,579			12,664
21	24,190,362		51	24,569,041	
		12,582			12,667
22	24,202,944		52	24,581,708	
		12,585			12,670
23	24,215,529		53	24,594,378	
		12,587			12,672
24	24,228,116		54	24,607,050	
		12,590			12,675
25	24,240,706		55	24,619,725	
		12,593			12,678
26	24,253,299		56	24,632,403	
		12,596			12,681
27	24,265,895		57	24,645,084	
		12,599			12,684
28	24,278,494		58	24,657,768	
		12,601			12,687
29	24,291,095		59	24,670,455	
		12,604			12,690
30	24,303,699		60	24,683,145	

38 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	24,683,145	12,693
1	24,695,838	12,695
2	24,708,533	12,698
3	24,721,231	12,701
4	24,733,932	12,704
5	24,746,636	12,707
6	24,759,343	12,710
7	24,772,053	12,713
8	24,784,766	12,716
9	24,797,482	12,719
10	24,810,201	12,722
11	24,822,923	12,724
12	24,835,647	12,727
13	24,848,374	12,730
14	24,861,104	12,733
15	24,873,837	12,736
16	24,886,573	12,739
17	24,899,312	12,742
18	24,912,054	12,745
19	24,924,799	12,748
20	24,937,547	12,751
21	24,950,298	12,754
22	24,963,052	12,757
23	24,975,809	12,760
24	24,988,569	12,763
25	25,001,332	12,765
26	25,014,097	12,768
27	25,026,865	12,771
28	25,039,636	12,774
29	25,052,410	12,777
30	25,065,187	

38 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.
30	25,065,187	12,780
31	25,077,967	12,783
32	25,090,750	12,786
33	25,103,536	12,789
34	25,116,325	12,792
35	25,129,117	12,795
36	25,141,912	12,798
37	25,154,710	12,801
38	25,167,511	12,804
39	25,180,315	12,807
40	25,193,122	12,810
41	25,205,932	12,813
42	25,218,745	12,816
43	25,231,561	12,819
44	25,244,380	12,822
45	25,257,202	12,825
46	25,270,027	12,828
47	25,282,855	12,831
48	25,295,686	12,834
49	25,308,520	12,837
50	25,321,357	12,840
51	25,334,197	12,843
52	25,347,040	12,846
53	25,359,886	12,849
54	25,372,735	12,852
55	25,385,587	12,855
56	25,398,442	12,858
57	25,411,300	12,861
58	25,424,161	12,864
59	25,437,025	12,867
60	25,449,892	

39 Degr.			39 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	25,449,892		30	25,837,325	
		12,870			12,962
1	25,462,762		31	25,850,287	
		12,873			12,965
2	25,475,635		32	25,863,252	
		12,876			12,969
3	25,488,511		33	25,876,221	
		12,879			12,972
4	25,501,390		34	25,889,193	
		12,882			12,975
5	25,514,272		35	25,902,168	
		12,885			12,978
6	25,527,157		36	25,915,146	
		12,888			12,981
7	25,540,045		37	25,928,127	
		12,891			12,984
8	25,552,936		38	25,941,111	
		12,894			12,987
9	25,565,830		39	25,954,098	
		12,898			12,990
10	25,578,738		40	25,967,088	
		12,901			12,994
11	25,591,639		41	25,980,082	
		12,904			12,997
12	25,604,533		42	25,993,079	
		12,907			13,000
13	25,617,440		43	26,006,079	
		12,910			13,003
14	25,630,350		44	26,019,072	
		12,913			13,006
15	25,643,263		45	26,032,078	
		12,916			13,009
16	25,656,179		46	26,045,097	
		12,919			13,012
17	25,669,098		47	26,058,109	
		12,922			13,016
18	25,682,020		48	26,071,125	
		12,925			13,019
19	25,694,945		49	26,084,144	
		12,928			13,022
20	25,707,873		50	26,097,166	
		12,931			13,025
21	25,720,804		51	26,110,191	
		12,934			13,028
22	25,733,738		52	26,123,219	
		12,937			13,031
23	25,746,675		53	26,136,250	
		12,941			13,035
24	25,759,616		54	26,149,285	
		12,944			13,038
25	25,772,560		55	26,162,323	
		12,947			13,041
26	25,785,507		56	26,175,364	
		12,950			13,044
27	25,798,457		57	26,188,408	
		12,953			13,047
28	25,811,410		58	26,201,455	
		12,956			13,050
29	25,824,366		59	26,214,505	
		12,959			13,054
30	25,837,325		60	26,227,559	

40 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	26,227,559	13,057
1	26,240,616	13,060
2	26,253,676	13,063
3	26,266,739	13,066
4	26,279,805	13,070
5	26,292,875	13,073
6	26,305,948	13,076
7	26,319,024	13,079
8	26,332,103	13,082
9	26,345,185	13,086
10	26,358,271	13,089
11	26,371,360	13,092
12	26,384,452	13,095
13	26,397,547	13,098
14	26,410,645	13,102
15	26,423,747	13,105
16	26,436,852	13,108
17	26,449,960	13,111
18	26,463,071	13,115
19	26,476,186	13,118
20	26,489,304	13,121
21	26,502,425	13,124
22	26,515,549	13,128
23	26,528,677	13,131
24	26,541,808	13,134
25	26,554,942	13,137
26	26,568,079	13,141
27	26,581,220	13,144
28	26,594,364	13,147
29	26,607,511	13,150
30	26,620,661	

40 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.
30	26,620,661	13,154
31	26,633,842	13,157
32	26,646,999	13,160
33	26,660,159	13,163
34	26,673,322	13,167
35	26,686,489	13,170
36	26,699,659	13,173
37	26,712,832	13,177
38	26,726,009	13,180
39	26,739,189	13,183
40	26,752,372	13,186
41	26,765,558	13,190
42	26,778,648	13,193
43	26,791,841	13,196
44	26,805,037	13,200
45	26,818,237	13,203
46	26,831,440	13,206
47	26,844,646	13,210
48	26,857,856	13,213
49	26,871,069	13,216
50	26,884,285	13,220
51	26,897,505	13,223
52	26,910,728	13,226
53	26,923,954	13,230
54	26,937,184	13,233
55	26,950,417	13,236
56	26,963,653	13,240
57	26,976,893	13,243
58	26,990,136	13,246
59	27,003,382	13,250
60	27,016,632	

41 Degr.			41 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	27,016,632		30	27,415,692	
		13,253			13,355
1	27,029,885		31	27,429,047	
		13,256			13,358
2	27,043,141		32	27,442,405	
		13,260			13,362
3	27,056,401		33	27,455,767	
		13,263			13,365
4	27,069,664		34	27,469,132	
		13,266			13,369
5	27,082,930		35	27,482,501	
		13,270			13,372
6	27,096,200		36	27,495,873	
		13,273			13,376
7	27,109,473		37	27,509,249	
		13,277			13,379
8	27,122,750		38	27,522,628	
		13,280			13,382
9	27,136,030		39	27,536,010	
		13,283			13,386
10	27,149,313		40	27,549,396	
		13,287			13,389
11	27,162,600		41	27,562,785	
		13,290			13,393
12	27,175,890		42	27,576,178	
		13,293			13,396
13	27,189,183		43	27,589,574	
		13,297			13,400
14	27,202,480		44	27,602,974	
		13,300			13,403
15	27,215,780		45	27,616,377	
		13,304			13,407
16	27,229,084		46	27,629,784	
		13,307			13,410
17	27,242,391		47	27,643,194	
		13,310			13,414
18	27,255,701		48	27,656,608	
		13,314			13,417
19	27,269,015		49	27,670,025	
		13,317			13,421
20	27,282,332		50	27,683,446	
		13,321			13,424
21	27,295,653		51	27,696,870	
		13,324			13,428
22	27,308,977		52	27,710,298	
		13,327			13,431
23	27,322,304		53	27,723,729	
		13,331			13,435
24	27,335,635		54	27,737,164	
		13,334			13,438
25	27,348,969		55	27,750,602	
		13,338			13,442
26	27,362,307		56	27,764,044	
		13,341			13,445
27	27,375,648		57	27,777,489	
		13,345			13,449
28	27,388,993		58	27,790,938	
		13,348			13,452
29	27,402,341		59	27,804,380	
		13,351			13,456
30	27,415,692		60	27,817,836	

42 Degr.

Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	27,817,836	
		13,459
1	27,831,295	13,463
2	27,844,758	13,466
3	27,858,224	13,470
4	27,871,694	13,473
5	27,885,167	13,477
6	27,898,644	13,481
7	27,912,125	13,484
8	27,925,609	13,488
9	27,939,097	13,491
10	27,952,588	13,495
11	27,966,083	13,498
12	27,979,581	13,502
13	27,993,083	13,505
14	28,006,588	13,509
15	28,020,097	13,513
16	28,033,610	13,516
17	28,047,126	13,520
18	28,060,646	13,523
19	28,074,169	13,527
20	28,087,696	13,531
21	28,101,227	13,534
22	28,114,761	13,538
23	28,128,299	13,541
24	28,141,840	13,545
25	28,155,385	13,548
26	28,168,933	13,552
27	28,182,485	13,556
28	28,196,041	13,559
29	28,209,600	13,563
30	28,223,163	

42 Degr.

Min.	Equal parts of a meridian, &c.	Difference of equal parts.
30	28,223,163	
		13,567
31	28,236,730	13,570
32	28,250,300	13,574
33	28,263,874	13,577
34	28,277,451	13,581
35	28,291,032	13,585
36	28,304,617	13,588
37	28,318,205	13,592
38	28,331,807	13,596
39	28,345,403	13,599
40	28,358,902	13,603
41	28,372,505	13,607
42	28,386,112	13,610
43	28,399,722	13,614
44	28,413,336	13,617
45	28,426,953	13,621
46	28,440,574	13,625
47	28,454,199	13,628
48	28,467,827	13,632
49	28,481,459	13,636
50	28,495,095	13,640
51	28,508,735	13,643
52	28,522,378	13,647
53	28,536,025	13,651
54	28,549,676	13,654
55	28,563,330	13,658
56	28,576,988	13,662
57	28,590,650	13,665
58	28,604,315	13,669
59	28,617,984	13,673
60	28,631,657	

43 Degr.			43 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	28,631,657		30	29,043,580	
		13,676			13,789
1	28,645,333	13,680	31	29,057,369	13,793
2	28,659,013	13,684	32	29,071,162	13,797
3	28,672,697	13,688	33	29,084,969	13,801
4	28,686,385	13,691	34	29,098,760	13,805
5	28,700,076	13,695	35	29,112,565	13,808
6	28,713,771	13,699	36	29,126,373	13,812
7	28,727,470	13,703	37	29,140,185	13,816
8	28,741,173	13,706	38	29,154,001	13,820
9	28,754,879	13,710	39	29,167,821	13,824
10	28,768,589	13,714	40	29,181,645	13,828
11	28,782,303	13,718	41	29,195,473	13,831
12	28,796,021	13,721	42	29,209,304	13,835
13	28,809,742	13,725	43	29,223,139	13,839
14	28,823,467	13,729	44	29,236,978	13,843
15	28,837,196	13,733	45	29,250,821	13,847
16	28,850,929	13,736	46	29,264,668	13,851
17	28,864,665	13,740	47	29,278,519	13,855
18	28,878,405	13,744	48	29,292,374	13,858
19	28,892,149	13,748	49	29,306,232	13,862
20	28,905,897	13,751	50	29,320,094	13,866
21	28,919,648	13,755	51	29,333,960	13,870
22	28,933,403	13,759	52	29,347,830	13,874
23	28,947,162	13,763	53	29,361,704	13,878
24	28,960,925	13,766	54	29,375,582	13,882
25	28,974,691	13,770	55	29,389,464	13,886
26	28,988,461	13,774	56	29,403,350	13,889
27	29,002,235	13,778	57	29,417,239	13,893
28	29,016,013	13,782	58	29,431,132	13,897
29	29,029,795	13,785	59	29,445,029	13,901
30	29,043,580		60	29,458,930	

44 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	29,458,930	13,905
1	29,472,835	13,909
2	29,486,744	13,913
3	29,500,657	13,917
4	29,514,574	13,921
5	29,528,495	13,925
6	29,542,420	13,929
7	29,556,349	13,932
8	29,570,281	13,936
9	29,584,217	13,940
10	29,598,157	13,944
11	29,612,101	13,948
12	29,626,049	13,952
13	29,640,001	13,956
14	29,653,957	13,960
15	29,667,917	13,964
16	29,681,881	13,968
17	29,695,849	13,972
18	29,709,821	13,976
19	29,723,797	13,980
20	29,737,777	13,984
21	29,751,761	13,988
22	29,765,749	13,992
23	29,779,741	13,996
24	29,793,737	14,000
25	29,807,737	14,004
26	29,821,741	14,008
27	29,835,749	14,012
28	29,849,761	14,016
29	29,863,777	14,020
30	29,877,797	

44 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.
30	29,877,797	14,024
31	29,891,821	14,028
32	29,905,849	14,032
33	29,919,881	14,036
34	29,933,917	14,040
35	29,947,957	14,044
36	29,962,001	14,048
37	29,976,049	14,052
38	29,990,101	14,056
39	30,004,157	14,060
40	20,018,217	14,064
41	30,032,281	14,068
42	30,046,349	14,072
43	30,060,421	14,076
44	30,074,497	14,080
45	30,088,577	14,084
46	30,102,661	14,088
47	30,116,749	14,093
48	30,130,842	14,097
49	30,144,939	14,100
50	30,159,039	14,105
51	30,173,144	14,109
52	30,187,253	14,113
53	30,201,366	14,117
54	30,215,483	14,121
55	30,229,604	14,125
56	30,243,729	14,129
57	30,257,858	14,133
58	30,271,991	14,138
59	30,286,129	14,142
60	30,300,271	

45 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	30,301,271	14,146
1	30,314,417	14,150
2	30,328,567	14,154
3	30,342,721	14,158
4	30,356,879	14,162
5	30,371,041	14,166
6	30,385,207	14,171
7	30,399,378	14,175
8	30,413,553	14,179
9	30,427,732	14,183
10	30,441,915	14,187
11	30,456,102	14,191
12	30,470 293	14,195
13	30,484,488	14,200
14	30 498,688	14.204
15	30,512,892	14,208
16	30,527,100	14,212
17	30 541,312	14.216
18	30,555,528	14,220
19	30,569,748	14,225
20	30,583,973	14,229
21	30,598,202	14,233
22	30,612,435	14.237
23	30,626,672	14,241
24	30,640.913	14,246
25	30,655,159	14,250
26	30.669.409	14.254
27	30,683,663	14,258
28	30,697,921	14,262
29	30.712,183	14,267
30	30,726,450	

45 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.
30	30,726,450	14,271
31	30,740,721	14,275
32	30,754,996	14,279
33	30,769,275	14,284
34	30,783,559	14,288
35	30,797,847	14,292
36	30,812,139	14,296
37	30,826,435	14,301
38	30,840,736	14,305
39	30,855,041	14,309
40	30,869,350	14,313
41	30,883,663	14,318
42	30,897,981	14,322
43	30,912,303	14,326
44	30,926,629	14,330
45	30,940,959	14,335
46	30,955,294	14,339
47	30,969,633	14,343
48	30,983,976	14,348
49	30,998,324	14,352
50	31,012,676	14,356
51	31,027,032	14,360
52	31,041,392	14,365
53	31,055,757	14.369
54	31,070,126	14,373
55	31,084,499	14,378
56	31,098,877	14,382
57	31,113,259	14,386
58	31,127,635	14,391
59	31,142,026	14,395
60	31,156,423	

46 Degr.			46 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	31,156,423		30	31,590,310	
		14,399			14,531
1	31,170,822		31	31,604,841	
		14,404			14,536
2	31,185,226		32	31,619,377	
		14,408			14,540
3	31,199,634		33	31,633,917	
		14,412			14,545
4	31,214,046		34	31,648,462	
		14,417			14,549
5	31,228,463		35	31,663,011	
		14,421			14,554
6	31,242,884		36	31,677,545	
		14,426			14,558
7	31,257,310		37	31,692,103	
		14,430			14,563
8	31,271,740		38	31,706,666	
		14,434			14,567
9	31,286,174		39	31,721,133	
		14,439			14,572
10	31,300,613		40	31,735,705	
		14,443			14,576
11	31,315,056		41	31,750,281	
		14,447			14,581
12	31,329,503		42	31,764,862	
		14,452			14,585
13	31,343,955		43	31,779,447	
		14,456			14,590
14	31,358,411		44	31,794,037	
		14,461			14,594
15	31,372,872		45	31,808,631	
		14,465			14,599
16	31,387,337		46	31,823,230	
		14,469			14,603
17	31,401,806		47	31,837,833	
		14,474			14,608
18	31,416,280		48	31,852,441	
		14,478			14,612
19	31,430,758		49	31,867,053	
		14,483			14,617
20	31,445,241		50	31,881,670	
		14,487			14,621
21	31,459,728		51	31,896,291	
		14,491			14,626
22	31,474,219		52	31,910,917	
		14,496			14,630
23	31,488,715		53	31,925,547	
		14,500			14,635
24	31,503,215		54	31,940,182	
		14,505			14,639
25	31,517,720		55	31,954,821	
		14,509			14,644
26	31,532,229		56	31,969,465	
		14,514			14,649
27	31,546,743		57	31,984,114	
		14,518			14,653
28	31,561,261		58	31,998,767	
		14,522			14,658
29	31,575,783		59	32,013,425	
		14,527			14,662
30	31,590,310		60	32,028,087	

47 Degr.			47 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	32,028,087		30	32,470,102	
		14,667			14,806
1	32,042,754		31	32,484,908	
		14,671			14,811
2	32,057,425		32	32,499,719	
		14,676			14,815
3	32,072,101		33	32,514,534	
		14,681			14,820
4	32,086,782		34	32,529,354	
		14,685			14,825
5	32,101,467		35	32,544,179	
		14,690			14,830
6	32,116,157		36	32,559,009	
		14,694			14,834
7	32,130,851		37	32,573,843	
		14,699			14,839
8	32,145,550		38	32,588,682	
		14,704			14,844
9	32,160,254		39	32,603,526	
		14,708			14,849
10	32,174,962		40	32,618,375	
		14,713			14,853
11	32,189,675		41	32,633,228	
		14,717			14,858
12	32,204,392		42	32,648,086	
		14,722			14,863
13	32,219,114		43	32,662,949	
		14,727			14,868
14	32,233,841		44	32,677,817	
		14,731			14,872
15	32,248,572		45	32,692,689	
		14,736			14,877
16	32,263,308		46	32,707,566	
		14,741			14,882
17	32,278,049		47	32,722,448	
		14,745			14,887
18	32,292,794		48	32,737,335	
		14,750			14,891
19	32,307,544		49	32,752,226	
		14,755			14,896
20	32,322,299		50	32,767,122	
		14,759			14,901
21	32,337,058		51	32,782,023	
		14,764			14,906
22	32,351,822		52	32,796,929	
		14,769			14,911
23	32,366,591		53	32,811,840	
		14,773			14,915
24	32,381,364		54	32,826,755	
		14,778			14,920
25	32,396,142		55	32,841,675	
		14,783			14,925
26	32,410,925		56	32,856,595	
		14,787			14,930
27	32,425,712		57	32,871,525	
		14,792			14,935
28	32,440,504		58	32,886,460	
		14,797			14,939
29	32,455,301		59	32,901,399	
		14,801			14,944
30	32,470,102		60	32,916,343	

48 Degr.			48 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	32,916,343		30	33,366,956	
		14,949			15,096
1	32,931,292		31	33,382,052	
		14,954			15,101
2	32,946,246		32	33,397,153	
		14,959			15,106
3	32,961,205		33	33,412,259	
		14,964			15,111
4	32,976,169		34	33,427,370	
		14,968			15,116
5	32,991,137		35	33,442,486	
		14,973			15,121
6	33,006,110		36	33,457,607	
		14,978			15,126
7	33,021,088		37	33,472,733	
		14,983			15,131
8	33,036,071		38	33,487,864	
		14,988			15,136
9	33,051,059		39	33,503,000	
		14,993			15,141
10	33,066,052		40	33,518,141	
		14,998			15,146
11	33,081,050		41	33,533,287	
		15,003			15,151
12	33,096,053		42	33,548,438	
		15,007			15,156
13	33,111,060		43	33,563,594	
		15,012			15,161
14	33,126,072		44	33,578,755	
		15,017			15,166
15	33,141,089		45	33,593,921	
		15,022			15,171
16	33,156,111		46	33,609,092	
		15,027			15,176
17	33,171,138		47	33,624,268	
		15,032			15,181
18	33,186,170		48	33,639,449	
		15,037			15,186
19	33,201,227		49	33,654,635	
		15,042			15,191
20	33,216,269		50	33,669,826	
		15,047			15,196
21	33,231,316		51	33,685,022	
		15,052			15,201
22	33,246,368		52	33,700,223	
		15,056			15,206
23	33,261,424		53	33,715,429	
		15,061			15,212
24	33,276,485		54	33,730,641	
		15,066			15,217
25	33,291,551		55	33,745,858	
		15,071			15,222
26	33,306,622		56	33,761,080	
		15,076			15,227
27	33,321,698		57	33,776,307	
		15,081			15,232
28	33,336,779		58	33,791,539	
		15,086			15,237
29	33,351,865		59	33,806,776	
		15,091			15,242
30	33,366,956		60	33,822,018	

49 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	33,822,018	15,247
1	33,837,265	15,252
2	33,852,517	15,257
3	33,867,774	15,262
4	33,883,036	15,268
5	33,898,304	15,273
6	33,913,577	15,278
7	33,928,855	15,283
8	33,944,138	15,288
9	33,959,426	15,293
10	33,974,719	15,298
11	33,990,017	15,304
12	34,005,321	15,309
13	34,020,630	15,314
14	34,035,944	15,319
15	34,051,263	15,324
16	34,066,587	15,329
17	34,081,916	15,335
18	34,097,251	15,340
19	34,112,591	15,345
20	34 127,936	15,350
21	34,143,286	15,355
22	34,158,641	15,361
23	34,173,102	15,366
24	34,189,368	15,371
25	34,204,739	15,376
26	34,220,115	15,381
27	34,235,496	15,387
28	34,250,883	15,392
29	34,266,275	15,397
30	34,281,672	

49 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.
30	34,281,672	15,402
31	34,297,074	15,408
32	34,312,482	15,413
33	34,327,895	15,418
34	34,343,313	15,423
35	34,358,733	15,429
36	34,374,162	15,434
37	34,389,596	15,439
38	34,405,035	15,445
39	34,420,480	15,450
40	34,435,930	15,455
41	34,451,385	15,460
42	34,466,845	15,466
43	34,482,311	15,471
44	34,497,782	15,476
45	34,513,258	15,482
46	34,528,740	15,487
47	34,544,227	15,492
48	34,559,719	15,498
49	34,575,217	15,503
50	34,590,720	15,508
51	34,606,228	15,514
52	34,621,742	15,519
53	34,637,261	15,524
54	34,652,785	15,530
55	34,668,315	15,535
56	34,683,850	15,541
57	34,699,391	15,546
58	34,714,937	15,551
59	34,730,488	15,557
60	34,746,045	

50 Degr.			50 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	34,746,045		30	35,215,280	
		15,562			15,726
1	34,761,607		31	35,231,006	
		15,568			15,732
2	34,777,175		32	35,246,738	
		15,573			15,738
3	34,792,748		33	35,262,476	
		15,578			15,743
4	34,808,326		34	35,278,219	
		15,584			15,749
5	34,823,910		35	35,293,968	
		15,589			15,754
6	34,839,499		36	35,309,722	
		15,595			15,760
7	34,855,094		37	35,325,482	
		15,600			15,765
8	34,870,694		38	35,341,247	
		15,605			15,771
9	34,886,299		39	35,357,028	
		15,611			15,777
10	34,901,910		40	35,372,805	
		15,616			15,782
11	34,917,526		41	35,388,587	
		15,622			15,788
12	34,933,148		42	35,404,375	
		15,627			15,793
13	34,948,775		43	35,420,168	
		15,633			15,799
14	34,964,408		44	35,435,967	
		15,638			15,805
15	34,980,046		45	35,451,772	
		15,644			15,810
16	34,995,690		46	35,467,582	
		15,649			15,816
17	35,011,339		47	35,483,398	
		15,655			15,822
18	35,026,994		48	35,499,220	
		15,660			15,827
19	35,042,654		49	35,515,047	
		15,666			15,833
20	35,058,320		50	35,530,880	
		15,671			15,839
21	35,073,991		51	35,546,719	
		15,677			15,844
22	35,089,668		52	35,562,563	
		15,682			15,850
23	35,105,350		53	35,578,413	
		15,688			15,856
24	35,121,038		54	35,594,269	
		15,693			15,861
25	35,136,731		55	35,610,130	
		15,699			15,867
26	35,152,430		56	35,625,997	
		15,704			15,873
27	35,168,134		57	35,641,870	
		15,710			15,878
28	35,183,844		58	35,657,748	
		15,715			15,884
29	35,199,559		59	35,673,632	
		15,721			15,890
30	35,215,280		60	35,689,522	

51 Degr. Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	35,689,522	15,895
1	35,705,417	15,901
2	35,721,318	15,907
3	35,737,225	15,913
4	35,753,138	15,918
5	35,769,056	15,924
6	35,784,980	15,930
7	35,800,910	15,936
8	35,816,846	15,941
9	35,832,787	15,947
10	35,848,734	15,953
11	35,864,687	15,959
12	35,880,646	15,964
13	35,896,610	15,970
14	35,912,580	15,976
15	35,928,556	15,982
16	35,944,538	15,987
17	35,960,525	15,993
18	35,976,518	15,999
19	35,992,517	16,005
20	36,008,522	16,011
21	36,024,533	16,017
22	36,040,550	16,022
23	36,056,572	16,028
24	36,072,600	16,034
25	36,088,634	16,040
26	36,104,674	16,046
27	36,120,720	16,052
28	36,136,772	16,058
29	36,152,830	16,063
30	36,168,893	

51 Degr. Min.	Equal parts of a meridian, &c.	Difference of equal parts.
30	36,168,893	16,069
31	36,184,962	16,075
32	36,201,037	16,081
33	36,217,118	16,087
34	36,233,205	16,093
35	36,249,298	16,099
36	36,265,397	16,105
37	36,281,502	16,111
38	36,297,613	16,116
39	36,313,729	16,122
40	36,329,851	16,128
41	36,345,979	16,134
42	36,362,113	16,140
43	36,378,253	16,146
44	36,394,399	16,152
45	36,410,551	16,158
46	36,426,709	16,164
47	36,442,873	16,170
48	36,459,043	16,176
49	36,475,219	16,182
50	36,491,401	16,188
51	36,507,589	16,194
52	36,523,783	16,200
53	36,539,983	16,206
54	36,556,189	16,212
55	36,572,401	16,218
56	36,588,619	16,224
57	36,604,843	16,230
58	36,621,073	16,236
59	36,637,309	16,242
60	36,653,551	

52 Degr.			52 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	36,653,551	16,248	30	37,143,656	16,433
1	36,669,799	16,254	31	37,160,089	16,439
2	36,686,053	16,260	32	37,176,528	16,445
3	36,702,313	16,266	33	37,192,973	16,451
4	36,718,579	16,273	34	37,209,424	16,458
5	36,734,852	16,279	35	37,225,882	16,464
6	36,751,131	16,285	36	37,242,346	16,470
7	36,767,416	16,291	37	37,258,816	16,476
8	36,783,707	16,297	38	37,275,292	16,483
9	36,800,004	16,303	39	37,291,775	16,489
10	36,816,307	16,309	40	37,308,264	16,495
11	36,832,616	16,315	41	37,324,759	16,501
12	36,848,931	16,321	42	37,341,260	16,508
13	36,865,252	16,327	43	37,357,768	16,514
14	36,881,579	16,334	44	37,374,282	16,520
15	36,897,913	16,340	45	37,390,802	16,527
16	36,914,253	16,346	46	37,407,329	16,533
17	36,930,599	16,352	47	37,423,862	16,539
18	36,946,951	16,358	48	37,440,401	16,546
19	36,963,309	16,364	49	37,456,947	16,552
20	36,979,673	16,370	50	37,473,499	16,558
21	36,996,043	16,377	51	37,490,057	16,565
22	37,012,420	16,383	52	37,506,622	16,571
23	37,028,803	16,389	53	37,523,193	16,578
24	37,045,192	16,395	54	37,539,771	16,584
25	37,061,587	16,401	55	37,556,355	16,590
26	37,077,988	16,408	56	37,572,945	16,597
27	37,094,396	16,414	57	37,589,542	16,603
28	37,110,810	16,420	58	37,606,145	16,609
29	37,127,230	16,426	59	37,622,754	16,616
30	37,143,656		60	37,639,370	

53 Degr.			53 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	37,639,370	16,622	30	38,140,859	16,818
1	37,655,992	16,629	31	38,157,677	16,824
2	37,672,621	16,635	32	38,174,501	16,831
3	37,689,256	16,642	33	38,191,332	16,838
4	37,705,898	16,648	34	38,208,170	16,844
5	37,722,546	16,655	35	38,225,014	16,851
6	37,739,201	16,661	36	38,241,865	16,858
7	37,755,862	16,667	37	38,258,723	16,864
8	37,772,529	16,674	38	38,275,587	16,871
9	37,789,203	16,680	39	38,292,458	16,878
10	37,805,883	16,687	40	38,309,336	16,884
11	37,822,570	16,693	41	38,326,220	16,891
12	37,839,263	16,700	42	38,343,111	16,898
13	37,855,963	16,706	43	38,360,009	16,904
14	37,872,669	16,713	44	38,376,913	16,911
15	37,889,382	16,719	45	38,393,824	16,918
16	37,906,101	16,726	46	38,410,742	16,925
17	37,922,827	16,732	47	38,427,667	16,931
18	37,939,559	16,739	48	38,444,598	16,948
19	37,956,298	16,745	49	38,461,546	16,945
20	37,973,043	16,752	50	38,478,491	16,501
21	37,989,795	16,759	51	38,495,442	16,958
22	38,006,554	16,765	52	38,512,400	16,965
23	38,023,319	16,772	53	38,529,365	16,972
24	38,040,091	16,778	54	38,546,337	16,979
25	38,056,869	16,785	55	38,563,316	16,985
26	38,073,654	16,791	56	38,580,301	16,992
27	38,090,445	16,798	57	38,597,293	16,999
28	38,107,243	16,805	58	38,614,292	17,006
29	38,124,048	16,811	59	38,631,298	17,013
30	38,140,859		60	38,648,311	

54 Degr. Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	38,648,311	17,019
1	38,665,330	17,026
2	38,682,356	17,033
3	38,699,389	17,040
4	38,716,429	17,047
5	38,733,476	17,054
6	38,750,530	17,060
7	38,767,590	17,067
8	38,784,657	17,074
9	38,801,731	17,081
10	38,818,812	17,088
11	38,835,900	17,095
12	38,852,995	17,102
13	38,870,097	17,109
14	38,887,206	17,115
15	38,904,321	17,122
16	38,921,443	17,129
17	38,938,572	17,136
18	38,955,708	17,143
19	38,972,851	17,150
20	38,990,001	17,157
21	39,007,158	17,164
22	39,024,324	17,171
23	39,041,495	17,178
24	39,058,673	17,185
25	39,075,858	17,192
26	39,093,050	17,199
27	39,110,249	17,206
28	39,127,455	17,213
29	39,144,668	17,220
30	39,161,888	

54 Degr. Min.	Equal parts of a meridian, &c.	Difference of equal parts.
30	39,161,888	17,227
31	39,179,115	17,234
32	39,196,349	17,241
33	39,213,590	17,248
34	39,230,838	17,255
35	39,248,093	17,262
36	39,265,356	17,269
37	39,282,625	17,276
38	39,299,901	17,284
39	39,317,185	17,291
40	39,334,476	17,298
41	39,351,774	17,305
42	39,369,179	17,302
43	39,386,481	17,319
44	39,403,800	17,326
45	39,421,126	17,333
46	39,438,459	17,340
47	39,455,799	17,348
48	39,473,147	17,355
49	39,490,502	17,362
50	39,507,864	17,369
51	39,525,233	17,376
52	39,542,609	17,383
53	39,559,992	17,391
54	39,577,383	17,398
55	39,594,781	17,405
56	39,612,186	17,412
57	39,629,598	17,420
58	39,647,018	17,427
59	39,664,445	17,434
60	39,681,879	

55 Degr.			55 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	39,681,879	17,441	30	40,208,291	17,662
1	39,699,320	17,448	31	40,225,953	17,670
2	39,716,768	17,456	32	40,243,623	17,677
3	39,734,224	17,463	33	40,261,300	17,685
4	39,751,687	17,470	34	40,278,985	17,692
5	39,769,157	17,478	35	40,296,677	17,700
6	39,786,635	17,485	36	40,314,377	17,707
7	39,804,120	17,492	37	40,332,084	17,715
8	39,821,612	17,499	38	40,349,799	17,722
9	39,839,111	17,507	39	40,367,521	17,730
10	39,856,618	17,514	40	40,385,251	17,737
11	39,874,122	17,521	41	40,402,988	17,745
12	39,891,643	17,529	42	40,420,733	17,752
13	39,909,172	17,536	43	40,438,485	17,760
14	39,926,708	17,543	44	40,456,245	17,768
15	39,944,251	17,551	45	40,474,013	17,775
16	39,961,802	17,558	46	40,491,788	17,783
17	39,979,360	17,566	47	40,509,571	17,790
18	39,996,926	17,573	48	40,527,361	17,798
19	40,014,499	17,580	49	40,545,159	17,806
20	40,032,079	17,588	50	40,562,965	17,813
21	40,049,667	17,595	51	40,580,778	17,821
22	40,067,262	17,603	52	40,598,599	17,829
23	40,084,865	17,610	53	40,616,428	17,836
24	40,102,465	17,617	54	40,634,264	17,844
25	40,120,092	17,625	55	40,652,108	17,852
26	40,137,717	17,632	56	40,669,960	17,859
27	40,155,349	17,640	57	40,687,819	17,867
28	40,172,989	17,647	58	40,705,686	17,875
29	40,190,636	17,655	59	40,723,561	17,882
30	40,208,291		60	40,741,443	

56 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	40,741,423	17,890
1	40,759,313	17,898
2	40,777,211	17,906
3	40,795,117	17,913
4	40,813,030	17,921
5	40,830,951	17,929
6	40,848,880	17,937
7	40,866,817	17,944
8	40,884,761	17,952
9	40,902,713	17,960
10	40,920,673	17,968
11	40,938,641	17,976
12	40,956,617	17,983
13	40,974,601	17,991
14	70,992,592	17,999
15	41,010,591	18,007
16	41,028,598	18,015
17	41,046,613	18,023
18	41,064,636	18,030
19	41,082,666	18,038
20	41,100,704	18,046
21	41,118,750	18,054
22	41,136,804	18,062
23	41,154,866	18,070
24	41,172,936	18,078
25	41,191,014	18,086
26	41,209,100	18,094
27	41,227,194	18,102
28	41,245,296	18,110
29	41,263,406	18,118
30	41,281,524	

56 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.
30	41,281,524	18,125
31	41,299,649	18,133
32	41,317,782	18,141
33	41,335,923	18,149
34	41,354,072	18,157
35	41,372,229	18,165
36	41,390,394	18,173
37	41,408,567	18,181
38	41,426,748	18,190
39	41,444,938	18,198
40	41,463,136	18,206
41	41,481,342	18,214
42	41,499,556	18,222
43	41,517,778	18,230
44	41,536,008	18,238
45	41,554,246	18,246
46	41,572,492	18,254
47	41,590,746	18,262
48	41,609,008	18,270
49	41,627,278	18,278
50	41,645,556	18,287
51	41,663,843	18,295
52	41,682,138	18,303
53	41,700,441	18,311
54	41,718,752	18,319
55	41,737,071	18,327
56	41,755,398	18,336
57	41,773,734	18,344
58	41,792,078	18,352
59	41,810,430	18,360
60	41,828,790	

57 Degr.			57 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	41,828,810		30	42,383,579	
		18,369			18,620
1	41,847,179		31	42,402,199	
		18,377			18,628
2	41,865,556		32	42,420,827	
		18,385			18,637
3	41,883,941		33	42,439,464	
		18,393			18,645
4	41,902,334		34	42,458,109	
		18,402			18,654
5	41,920,736		35	42,476,763	
		18,410			18,662
6	41,939,146		36	42,495,425	
		18,418			18,671
7	41,957,564		37	42,514,096	
		18,426			18,679
8	41,975,990		38	42,532,775	
		18,435			18,688
9	41,994,425		39	42,551,463	
		18,443			18,697
10	42,012,868		40	42,570,160	
		18,451			18,705
11	42,031,319		41	42,588,865	
		18,460			18,714
12	42,049,779		42	42,607,579	
		18,468			18,722
13	42,068,247		43	42,626,301	
		18,476			18,731
14	42,086,723		44	42,645,032	
		18,485			18,740
15	42,105,208		45	42,663,772	
		18,493			18,748
16	42,123,701		46	42,682,520	
		18,501			18,757
17	42,142,202		47	42,701,277	
		18,510			18,766
18	42,160,712		48	42,720,043	
		18,518			18,774
19	42,179,230		49	42,738,817	
		18,527			18,783
20	42,197,757		50	42,757,600	
		18,535			18,792
21	42,216,392		51	42,776,392	
		18,543			18,800
22	42,234,935		52	42,795,192	
		18,552			18,809
23	42,253,487		53	42,814,001	
		18,560			18,818
24	42,272,047		54	42,832,819	
		18,569			18,826
25	42,290,608		55	42,851,645	
		18,577			18,835
26	42,309,185		56	42,870,480	
		18,586			18,844
27	42,327,771		57	42,889,324	
		18,594			18,853
28	42,346,365		58	42,908,177	
		18,603			18,862
29	42,364,968		59	42,927,039	
		18,611			18,870
30	42,383,579		60	42,945,909	

58 Degr.			58 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	42,945,909		30	43,516,147	
		18,879			19,147
1	42,964,788	18,888	31	43,535,294	19,156
2	42,983,676	18,897	32	43,554,450	19,166
3	43,002,573		33	43,573,616	
		18,906			19,175
4	43,021,479	18,914	34	43,592,791	19,184
5	43,040,393	18,923	35	43,611,975	19,193
6	43,059,316		36	43,631,168	
		18,932			19,202
7	43,078,248	18,941	37	43,650,370	19,211
8	43,097,189	18,950	38	43,669,581	19,220
9	43,116,139		39	43,688,801	
		18,959			19,230
10	43,135,098	18,968	40	43,708,031	19,239
11	43,154.066	18,976	41	43,727,270	19,248
12	43,173,042		42	43,746,518	
		18,985			19,257
13	43,192,027	18,994	43	43,765,775	19,267
14	43,211,021	19,003	44	43,785,042	19,276
15	43,230,024		45	43,804,318	
		19,012			19,285
16	43,249,036	19,021	46	43,823,603	19,294
17	43,268,057	19,030	47	43,842,897	19,304
18	43,287,087		48	43,862,201	
		19,039			19,313
19	43,306,126	19,048	49	43,881,514	19,322
20	43,325,174	19,057	50	43,900,836	19,331
21	43,344,231		51	43,920,167	
		19,066			19,341
22	43,363,297	19,075	52	43,939,508	19,350
23	43,382,372	19,084	53	43,958,858	19,359
24	43,401,458		54	43,978,217	
		19,093			19,369
25	43,420,551	19,102	55	43,997,586	19,378
26	43,439,653	19,111	56	44,016,964	19,387
27	43,458,764		57	44,036,351	
		19,120			19,397
28	43,477,880	19,129	58	44,055,748	19,406
29	43,497,009	19,138	59	44,075,154	19,416
30	43,516,147		60	44,094,570	

59 Degr.			59 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	44,094,550		30	44,681,439	
		19,425			19,712
1	44,113,975		31	44,701,151	
		19,434			19,722
2	44,133,409		32	44,720,873	
		19,444			19,732
3	44,152,853		33	44,740,605	
		19,453			19,741
4	44,172,306		34	44,760,346	
		19,463			19,751
5	44,191,769		35	44,780,097	
		19,472			19,761
6	44,211,241		36	44,799,857	
		19,482			19,771
7	44,230,723		37	44,819,628	
		19,491			19,781
8	44,250,214		38	44,839,409	
		19,501			19,790
9	44,269,715		39	44,859,199	
		19,510			19,800
10	44,289,225		40	44,878,999	
		19,520			19,810
11	44,308,745		41	44,898,809	
		19,529			19,820
12	44,328,274		42	44,918,629	
		19,539			19,830
13	44,347,813		43	44,938,459	
		19,548			19,840
14	44,367,361		44	44,958,299	
		19,558			19,850
15	44,386,919		45	44,978,149	
		19,567			19,860
16	44,406,486		46	44,998,009	
		19,577			19,869
17	44,426,063		47	45,017,878	
		19,586			19,879
18	44,445,649		48	45,037,757	
		19,596			19,889
19	44,465,245		49	45,057,646	
		19,606			19,899
20	44,484,851		50	45,077,545	
		19,615			19,909
21	44,504,466		51	45,097,454	
		19,625			19,919
22	44,524,091		52	45,117,373	
		19,635			19,929
23	44,543,726		53	45,137,302	
		19,644			19,939
24	44,563,370		54	45,157,241	
		19,654			19,949
25	44,583,024		55	45,177,199	
		19,664			19,959
26	44,602,688		56	45,197,149	
		19,673			19,969
27	44,622,361		57	45,217,118	
		19,683			19,979
28	44,642,044		58	45,237,097	
		19,693			19,989
29	44,661,737		59	45,257,086	
		19,702			20,000
30	44,681,439		60	45,277,086	

60 Degr.			60 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	45,277,106		30	45,881,827	
		20,010			20,318
1	45,297,116		31	45,902,145	
		20,020			20,328
2	45,317,136		32	45,922,473	
		20,030			20,339
3	45,337,166		33	45,942,812	
		20,040			20,349
4	45,357,206		34	45,963,161	
		20,050			20,360
5	45,377,256		35	45,983,521	
		20,060			20,370
6	45,397,316		36	46,003,891	
		20,070			20,381
7	45,417,386		37	46,024,272	
		20,080			20,391
8	45,437,466		38	46,044,663	
		20,091			20,402
9	45,457,557		39	46,065,065	
		20,101			20,412
10	45,477,658		40	46,085,477	
		20,111			20,423
11	45,497,769		41	46,105,900	
		20,121			20,433
12	45,517,890		42	46,126,333	
		20,132			20,444
13	45,538,022		43	46,146,777	
		20,142			20,455
14	45,558,164		44	46,167,232	
		20,152			20,465
15	45,578,316		45	46,187,697	
		20,162			20,476
16	45,598,478		46	46,208,173	
		20,173			20,487
17	45,618,651		47	46,228,660	
		20,183			20,497
18	45,638,834		48	46,249,157	
		20,193			20,508
19	45,659,027		49	46,269,665	
		20,203			20,519
20	45,679,230		50	46,290,184	
		20,214			20,529
21	45,699,444		51	46,310,713	
		20,224			20,540
22	45,719,668		52	46,331,253	
		20,234			20,551
23	45,739,902		53	46,351,814	
		20,245			20,561
24	45,760,147		54	46,372,365	
		20,255			20,572
25	45,780,402		55	46,392,937	
		20,266			20,583
26	45,800,668		56	46,413,520	
		20,276			20,594
27	45,820,944		57	46,434,114	
		20,286			20,605
28	45,841,230		58	46,454,719	
		20,297			20,615
29	45,861,527		59	46,475,334	
		20,307			20,626
30	45,881,827		60	46,495,960	

61 Degr.			61 Degr.		
Min	Equal parts of a meridian, &c.	Difference of equal parts.	Min	Equal parts of a meridian, &c.	Difference of equal parts.
0	46,495,960		30	47,119,836	
		20,637			20,968
1	46,516,597		31	47,140,804	
		20,648			20,979
2	46,537,245		32	47,161,783	
		20,659			20,991
3	46,557,904		33	47,182,774	
		20,670			21,002
4	46,578,574		34	47,203,776	
		20,680			21,013
5	46,599,250		35	47,224,789	
		20,691			21,025
6	46,619,941		36	47,245,814	
		20,702			21,036
7	46,640,643		37	47,266,850	
		20,713			21,047
8	46,661,356		38	47,287,897	
		20,724			21,058
9	46,682,080		39	47,308,955	
		20,735			21,070
10	46,702,815		40	47,330,025	
		20,746			21,081
11	46,723,561		41	47,351,106	
		20,757			21,093
12	46,744,318		42	47,372,199	
		20,768			21,104
13	46,765,086		43	47,393,383	
		20,779			21,115
14	46,785,865		44	47,414,418	
		20,790			21,127
15	46,806,655		45	47,435,545	
		20,801			21,138
16	46,827,456		46	47,456,683	
		20,812			21,150
17	46,848,268		47	47,477,833	
		20,823			21,161
18	46,869,091		48	47,498,984	
		20,834			21,173
19	46,889,925		49	47,520,167	
		20,845			21,184
20	46,910,770		50	47,541,351	
		20,856			21,196
21	46,931,626		51	47,562,547	
		20,868			21,207
22	46,952,494		52	27,583,754	
		20,879			21,219
23	46,973,373		53	47,604,973	
		20,890			21,230
24	46,994,263		54	47,626,203	
		20,901			21,242
25	47,015,164		55	47,647,445	
		20,912			21,254
26	47,036,076		56	47,668,699	
		20,923			21,265
27	47,056,999		57	47,689,964	
		20,934			21,277
28	47,077,923		58	47,711,241	
		20,946			21,288
29	47,098,879		59	47,732,529	
		20,957			21,300
30	47,119,836		60	47,753,829	

62 Degr.		
Min.	Equal parts of a meridian &c.	Difference of equal parts.
0	47,753,829	
		21,312
1	47,775,141	
		21,323
2	47,796,464	
		21,335
3	47,817,799	
		21,347
4	47,839,146	
		21,358
5	47,860,504	
		21,370
6	47,881,874	
		21,382
7	47,903,256	
		21,394
8	47,924,650	
		21,406
9	47,946,056	
		21,417
10	47,967,473	
		21,429
11	47,988,902	
		21,441
12	48,010,343	
		21,453
13	48,031,796	
		21,465
14	48,053,261	
		21,476
15	48,074,737	
		21,488
16	48,096,225	
		21,500
17	48,117,725	
		21,512
18	48,139,237	
		21,524
19	48,160,761	
		21,536
20	48,182,297	
		21,548
21	58,203,845	
		21,560
22	48,225,405	
		21,572
23	48,246,977	
		21,584
24	48,268,561	
		21,596
25	48,290,157	
		21,608
26	48,311,765	
		21,620
27	48,333,385	
		21,632
28	48,355,017	
		21,644
29	48,376,661	
		21,656
30	48,398,317	

62 Degr.		
Min.	Equal parts of a meridian. &c.	Difference of equal parts.
30	48,398,317	
		21,668
31	48,419,985	
		21,681
32	48,441,666	
		21,693
33	48,463,359	
		21,705
34	48,485,064	
		21,717
35	48,506,781	
		21,729
36	48,528,510	
		21,741
37	48,550,251	
		21,754
38	48,572,005	
		21,766
39	48,593,771	
		21,778
40	48,615,549	
		21,790
41	48,637,339	
		21,803
42	48,659,142	
		21,815
43	48,680,957	
		21,827
44	48,702,784	
		21,840
45	48,724,624	
		21,852
46	48,746,476	
		21,864
47	48,768,340	
		21,877
48	48,790,217	
		21,889
49	48,812,106	
		21,901
50	48,834,017	
		21,914
51	48,855,821	
		21,926
52	48,877,747	
		21,939
53	48,899,686	
		21,951
54	48,921,637	
		21,964
55	48,943,601	
		21,976
56	48,965,557	
		21,989
57	48,987,566	
		22,001
58	49,009,567	
		22,014
59	49,031,581	
		22,026
60	49,053,607	

63 Degr.			63 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	49,053,607		30	49,720,324	
		22,039			22,424
1	49,075,646		31	49,742,748	
		22,052			22,437
2	49,097,698		32	49,765,185	
		22,064			22,450
3	49,119,762		33	49,787,635	
		22,077			22,464
4	49,141,839		34	49,810,099	
		22,089			22,477
5	49,163,928		35	49,832,576	
		22,102			22,490
6	49,186,030		36	49,855,066	
		22,115			22,503
7	49,208,145		37	49,877,568	
		22,128			22,516
8	49,230,273		38	49,900,084	
		22,140			22,529
9	49,252,413		39	49,922,613	
		22,153			22,543
10	49,274,566		40	49,945,156	
		22,166			22,556
11	49,296,732		41	49,967,712	
		22,178			22,569
12	49,318,910		42	49,990,281	
		22,191			22,583
13	49,341,101		43	50,012,864	
		22,204			22,596
14	49,363,305		44	50,035,460	
		22,217			22,609
15	49,385,522		45	50,058,069	
		22,230			22,623
16	49,407,752		46	50,080,692	
		22,243			22,636
17	49,429,995		47	50,103,328	
		22,255			22,649
18	49,452,250		48	50,125,977	
		22,268			22,663
19	49,474,518		49	50,148,640	
		22,281			22,676
20	49,496,799		50	50,171,316	
		22,294			22,690
21	49,519,093		51	50,194,006	
		22,307			22,703
22	49,541,400		52	50,216,709	
		22,320			22,716
23	49,563,720		53	50,239,425	
		22,333			22,730
24	49,586,053		54	50,262,155	
		22,346			22,743
25	49,608,399		55	50,284,898	
		22,359			22,757
26	49,630,758		56	50,307,655	
		22,372			22,770
27	49,653,130		57	50,330,425	
		22,385			22,784
28	49,675,515		58	50,353,209	
		22,398			22,798
29	49,697,913		59	50,376,007	
		22,411			22,811
30	49,720,324		60	50,398,818	

64 Degr.			64 Degr.		
Min.	Equal parts of a meridian. &c.	Difference of equal parts.	Min.	Equal parts of a meridian. &c.	Difference of equal parts.
0	50,398,81[illegible]		30	51,089,566	
		22,825			23,242
1	50,421,643	22,838	31	51,112,808	23,256
2	50,444,461	22,852	32	51,136,064	23,270
3	50,467,313		33	51,159,334	
		22,866			23,285
4	50,490,179	22,879	34	51,182,619	23,299
5	50,513,058	22,893	35	51,205,918	23,313
6	50,535,951		36	51,229,233	
		22,907			23,327
7	50,558,858	22,921	37	51,252,560	23,342
8	50,581,779	22,934	38	51,275,902	23,356
9	50,604,713		39	51,299,258	
		22,948			23,370
10	50,627,661	22,962	40	51,322,628	23,385
11	50,650,623	22,976	41	51,346,013	23,399
12	50,673,599		42	51,369,412	
		22,990			23,414
13	50,696,589	23,003	43	51,392,826	23,428
14	50,719,592	23,017	44	51,416,254	23,442
15	50,742,609		45	51,439,696	
		23,031			23,457
16	50,765,660	23,045	46	51,463,153	23,471
17	50,788,705	23,059	47	51,486,624	23,486
18	50,811,764		48	51,510,110	
		23,073			23,500
19	50,834,837	23,087	49	51,533,610	23,515
20	50,857,924	23,101	50	51,557,125	23,529
21	50,881,025		51	51,580,654	
		23,115			23,544
22	50,904,140	23,129	52	51,604,198	23,559
23	50,927,269	23,143	53	51,627,757	23,573
24	50,950,412		54	51,651,330	
		23,157			23,588
25	50,973,569	23,171	55	51,674,918	23,603
26	50,996,740	23,185	56	51,698,521	23,617
27	51,019,925		57	51,722,138	
		23,199			23,632
28	51,043,124	23,214	58	51,745,770	23,647
29	51,066,338	23,228	59	51,769,417	23,662
30	51,089,566		60	51,793,079	

65 Degr.			65 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	51,793,079		30	52,509,884	
		23,676			24,129
1	51,816,755		31	52,534,013	
		23,691			24,145
2	51,840,446		32	52,558,158	
		23,706			24,160
3	51,864,152		33	52,582,318	
		23,721			24,175
4	51,887,873		34	52,606,493	
		23,736			24,191
5	51,911,609		35	52,630,684	
		23,750			24,206
6	51,935,359		36	52,654,890	
		23,765			24,222
7	51,959,124		37	52,679,112	
		23,780			24,238
8	51,982,904		38	52,703,350	
		23,795			24,253
9	52,006,699		39	52,727,603	
		23,810			24,269
10	52,030,509		40	52,751,872	
		23,825			24,284
11	52,054,334		41	52,776,156	
		23,840			24,300
12	52,078,174		42	52,800,456	
		23,855			24,316
13	52,102,029		43	52,824,772	
		23,870			24,331
14	52,125,899		44	52,849,103	
		23,885			24,347
15	52,149,784		45	52,873,450	
		23,900			24,363
16	52,173,684		46	52,897,813	
		23,915			24,379
17	52,197,599		47	52,922,192	
		23,931			24,394
18	52,221,530		48	52,946,586	
		23,946			24,410
19	52,245,476		49	52,970,996	
		23,961			24,426
20	52,269,437		50	52,995,422	
		23,976			24,442
21	52,293,413		51	53,019,864	
		23,991			24,458
22	52,317,404		52	53,044,322	
		24,006			24,474
23	52,341,410		53	53,068,796	
		24,022			24,489
24	52,365,432		54	53,093,285	
		24,037			24,505
25	52,389,469		55	53,117,790	
		24,052			24,521
26	52,413,521		56	53,142,311	
		24,068			24,537
27	52,437,589		57	53,166,848	
		24,083			24,553
28	52,461,672		58	53,191,401	
		24,098			24,569
29	52,485,770		59	53,215,970	
		24,114			24,585
30	52,509,884		60	53,240,555	

66 Degr.			66 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	53,240,555	24,602	30	53,985,698	25,095
1	53,265,157	24,618	31	54,010,793	25,112
2	53,289,775	24,634	32	54,035,905	25,128
3	53,314,409	24,650	33	54,061,033	25,145
4	53,339,059	24,666	34	54,086,178	25,162
5	53,363,725	24,682	35	54,111,340	25,179
6	53,388,407	24,698	36	54,136,519	25,196
7	53,413,105	24,715	37	54,161,715	25,213
8	53,437,820	24,731	38	54,186,928	25,230
9	53,462,551	24,747	39	54,212,158	25,247
10	53,487,298	24,764	40	54,237,405	25,264
11	53,512,062	24,780	41	54,262,669	25,281
12	53,536,842	24,796	42	54,287,950	25,298
13	53,561,638	24,813	43	54,313,248	25,315
14	53,586,451	24,829	44	54,338,563	25,332
15	53,611,280	24,845	45	54,363,895	25,350
16	53,636,125	24,862	46	54,389,245	25,367
17	53,660,987	24,878	47	54,414,612	25,384
18	53,685,865	24,895	48	54,439,996	25,401
19	53,710,760	24,911	49	54,465,397	25,418
20	53,735,671	24,928	50	54,490,815	25,436
21	53,760,599	24,944	51	54,516,251	25,453
22	53,785,543	24,961	52	54,541,704	25,470
23	53,810,514	24,978	53	54,567,174	25,488
24	53,835,482	24,994	54	54,592,662	25,505
25	53,860,476	25,011	55	54,618,167	25,523
26	53,885,487	25,028	56	54,643,690	25,540
27	53,910,515	25,044	57	54,669,230	25,558
28	53,935,559	25,061	58	54,694,788	25,575
29	53,960,620	25,078	59	54,720,363	25,593
30	53,985,698		60	54,745,956	

67 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	54,745,956	
1	54,771,566	25,610
2	54,797,194	25,628
3	54,822,839	25,645
4	54,848,502	25,663
5	54,874,183	25,681
6	54,899,881	25,698
7	54,925,597	25,716
8	54,951,331	25,734
9	54,977,082	25,751
10	55,002,851	25,769
11	55,028,638	25,787
12	55,054,443	25,805
13	55,080,266	25,823
14	55,106,107	25,841
15	55,131,966	25,859
16	55,157,843	25,877
17	55,183,738	25,895
18	55,209,651	25,913
19	55,235,562	25,931
20	55,261,531	25,949
21	55,287,498	25,967
22	55,313,483	25,985
23	55,339,486	26,003
24	55,365,507	26,021
25	55,391,546	26,039
26	55,417,604	26,058
27	55,443,680	26,076
28	55,469,774	26,094
29	55,495,886	26,112
30	55,522,017	26,131

67 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.
30	55,522,017	
31	55,548,166	26,149
32	55,574,334	26,168
33	55,600,520	26,186
34	55,626,724	26,204
35	55,652,947	26,223
36	55,679,188	26,241
37	55,705,448	26,260
38	55,731,726	26,278
39	55,758,023	26,297
40	55,784,339	26,316
41	55,810,673	26,334
42	55,837,026	26,353
43	55,863,398	26,372
44	55,889,788	26,390
45	55,916,197	26,409
46	55,942,625	26,428
47	55,969,072	26,447
48	55,995,538	26,466
49	56,022,023	26,485
50	56,048,526	26,503
51	56,075,048	26,522
52	56,101,589	26,541
53	56,128,149	26,560
54	56,154,728	26,579
55	56,181,326	26,598
56	56,207,944	26,618
57	56,234,581	26,637
58	56,261,237	26,656
59	56,287,912	26,675
60	56,314,606	26,694

68 Degr.			68 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	56,314,606		30	57,124,510	
		26,713			27,305
1	56,341,319		31	57,151,815	
		26,733			27,325
2	56,368,052		32	57,179,140	
		26,752			27,345
3	56,394,804		33	57,206,485	
		26,771			27,365
4	56,421,575		34	57,233,850	
		26,791			27,386
5	76,448,366		35	57,261,236	
		26,810			27,406
6	56,475,176		36	57,288,642	
		26,829			27,426
7	56,502,005		37	57,316,068	
		26,849			27,447
8	56,528,854		38	57,343,515	
		26,868			27,467
9	56,555,722		39	57,370,982	
		26,888			27,488
10	56,582,610		40	57,398,470	
		26,907			27,508
11	56,609,517		41	57,425,978	
		26,927			27,529
12	56,636,444		42	57,453,507	
		26,947			27,549
13	56,663,391		43	57,481,056	
		26,966			27,570
14	56,690,357		44	57,508,626	
		26,986			27,590
15	56,717,343		45	53,536,216	
		27,006			27,611
16	56,744,349		46	57,563,827	
		27,025			27,632
17	56,771,374		47	57,591,459	
		27,045			27,652
18	56,798,419		48	57,619,111	
		27,065			27,673
19	56,825,484		49	57,646,784	
		27,085			27,694
20	56,852.569		50	57,674,478	
		27,104			27,715
21	56,879,673		51	57,702,193	
		27,124			27,736
22	56,906,797		52	57,729,929	
		27,144			27,757
23	56,933,941		53	57,757,686	
		27,164			27,778
24	56,961,105		54	57,785,464	
		27,184			27,798
25	56,988,289		55	57,813,262	
		27,204			27,819
26	57,015,493		56	57,841,081	
		27,224			27,841
27	57,042,717		57	57,868,922	
		27,244			27,862
28	57,069,961		58	57,896,784	
		27,264			27,883
29	57,097,225		59	57,924,667	
		27,285			27,904
30	57,124,510		60	57,952,571	

69 Degr.			69 Degr.		
Min.	Equal parts of a meridian &c.	Difference of equal parts.	Min.	Equal parts of a meridian &c.	Difference of equal parts.
0	57,952,571		30	58,799,682	
		27,925			28,576
1	57,980,496		31	58,828,258	
		27,946			28,599
2	58,008,442		32	58,856,857	
		27,967			28,621
3	58,036,409		33	58,885,478	
		27,989			28,643
4	58,064,398		34	58,914,121	
		28,010			28,666
5	58,092,408		35	58,942,787	
		28,031			28,688
6	58,120,439		36	58,971,475	
		28,053			28,710
7	58,148,492		37	59,000,185	
		28,074			28,733
8	58,176,566		38	59,028,918	
		28,095			28,755
9	58,204,661		39	59,057,673	
		28,117			28,778
10	58,232,778		40	59,086,451	
		28,138			28,801
11	58,260,916		41	59,115,252	
		28,160			28,823
12	58,289,076		42	59,144,075	
		28,182			28,846
13	58,317,258		43	59,172,921	
		28,203			28,869
14	58,345,461		44	59,201,790	
		28,225			28,891
15	58,373,686		45	59,230,681	
		28,247			28,914
16	58,401,933		46	59,259,595	
		28,268			28,937
17	58,430,201		47	59,288,532	
		28,290			28,960
18	58,458,491		48	59,317,492	
		28,312			28,983
19	58,486,803		49	59,346,475	
		28,334			29,006
20	58,515,137		50	59,375,481	
		28,356			29,029
21	58,543,493		51	59,404,510	
		28,377			29,052
22	58,571,870		52	59,433,562	
		28,399			29,075
23	58,600,269		53	59,462,637	
		28,421			29,098
24	58,628,690		54	59,491,735	
		28,443			29,121
25	58,657,133		55	59,520,856	
		28,465			29,144
26	58,685,598		56	59,550 000	
		28,488			29,168
27	58,714,086		57	59,579,168	
		28,510			29,191
28	58,742,596		58	59,608,359	
		28,532			29,214
29	58,771,128		59	59,637,573	
		28 554			29,238
30	58,799,682		60	59,666,811	

70 Degr.			70 Degr.		
Min.	Equal parts of a meridian. &c	Difference of qual parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	59,666,811	29,261	30	60,555,005	29,982
1	59,696,072	29,284	31	60,584,987	30,006
2	59,725,356	29,308	32	60,614,993	30,031
3	59,754,664	29,331	33	60,645,024	30,056
4	59,783,995	29,355	34	60,675,080	30,081
5	59,813,350	29,378	35	60,705,161	30,105
6	59,842,728	29,402	36	60,735,266	30,130
7	59,872,130	29,426	37	60,765,396	30,155
8	59,901,556	99,449	38	60,795,551	30,180
9	59,931,015	29,473	39	60,825,731	30,205
10	59,960,488	29,497	40	60,855,936	30,230
11	59,989,985	29,521	41	60,886,166	30,255
12	60,019,506	29,545	42	60,916,421	30,281
13	60,049,051	29,569	43	60,946,702	30,306
14	60,078,620	29,593	44	60,977,008	30,331
15	60,108,213	29,617	45	61,007,339	30,356
16	60,137,830	29,641	46	61,037,695	30,382
17	60,167,471	29,665	47	61,068,077	30,407
18	60,197,136	29,689	48	61,098,484	30,432
19	60,226,825	29,713	49	61,128,916	30,458
20	60,256,538	29,737	50	61,159,374	30,483
21	60,286,275	29,761	51	61,189,857	30,509
22	60,316,036	29,786	52	61,220,366	30,535
23	60,345,822	29,810	53	61,250,901	30,560
24	60,375,632	29,834	54	61,281,461	30,586
25	60,405,466	29,859	55	61,311,947	30,612
26	60,435,325	29,883	56	61,342,559	30,637
27	60,465,208	29,908	57	61,373,196	30,663
28	60,495,116	29,932	58	61,403,859	30,689
29	60,525,048	29,957	59	61,434,548	30,715
30	60,555,005		60	61,465,263	

71 Degr. Min.	Equal parts of a meridian &c.	Difference of qual parts.
0	61,465,263	
		30,741
1	61,496,004	
		30,767
2	61,526,771	
		30,793
3	61,557,564	
		30,819
4	61,588,383	
		30,845
5	61,619,228	
		30,872
6	61,650,100	
		30,898
7	61,680,998	
		30,924
8	61,711,922	
		30,950
9	61,742,872	
		30,977
10	61,773,849	
		31,003
11	61,804,852	
		31,030
12	61,835,882	
		31,056
13	61,866,938	
		31,083
14	61,898,021	
		31,110
15	61,929,131	
		31,136
16	61,960,267	
		31,163
17	61,991,430	
		31,190
18	62,022,620	
		31,217
19	62,053,837	
		31,243
20	62,085,080	
		31,270
21	62,116,350	
		31,297
22	62,147,647	
		31,324
23	62,178,971	
		31,351
24	62,210,322	
		31,379
25	62,241,701	
		31,406
26	62,273,097	
		31,433
27	62,304,540	
		31,460
28	62,336,000	
		31,488
29	62,367,488	
		31,515
30	62,399,003	

71 Degr. Min.	Equal parts of meridian &c.	Difference of qual parts.
30	62,399,003	
		31,542
31	62,430,545	
		31,570
32	62,462,115	
		31,597
33	62,493,712	
		31,625
34	62,525,337	
		31,653
35	62,556,990	
		31,680
36	62,588,670	
		31,708
37	62,620,378	
		31,736
38	62,652,114	
		31,764
39	62,683,878	
		31,791
40	62,715,669	
		31,819
41	62,747,478	
		31,847
42	62,779,335	
		31,875
43	62,811,210	
		31,904
44	62,843,114	
		31,932
45	62,875,046	
		31,960
46	62,907,006	
		31,988
47	62,938,994	
		32,016
48	62,971,010	
		32,045
49	63,003,055	
		32,073
50	63,035,128	
		32,102
51	63,067,230	
		32,130
52	63,099,360	
		32,159
53	63,131,519	
		32,187
54	63,163,706	
		32,216
55	63,195,922	
		32 245
56	63,228,167	
		32,274
57	63,260,441	
		32,302
58	63,292,743	
		32 331
59	63,325,074	
		32,360
60	63,357,434	

72 Degr.			72 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	63,357,434		30	64,341,976	
		32,389			33,285
1	63,389,823	32,418	31	64,375,261	33,316
2	63,422,241	32,447	32	64,408,577	33,347
3	63,454,688		33	64,441,924	
		32,477			33,378
4	63,487,165	32,506	34	64,475,302	33,409
5	63,519,671	32,535	35	64,508,711	33,440
6	63,552,206		36	64,542,171	
		32,564			33,471
7	63,584,770	32,594	37	64,575,622	33,502
8	63,617,364	32,623	38	64,609,124	33,533
9	63,649,987		39	64,642,657	
		32,653			33,564
10	63,682,640	32,682	40	64,676,221	33,596
11	63,715,322	32,712	41	64,709,817	33,627
12	63,748,034		42	64,743,444	
		32,741			33,658
13	63,780,775	32,771	43	64,777,102	33,690
14	63,813,546	32,801	44	64,810,792	33,722
15	63,846,347		45	64,844,514	
		32,831			33,753
16	63,879,178	32,861	46	64,878,267	33,785
17	63,912,039	32,891	47	64,912,052	33,817
18	63,944,930		48	64,945,869	
		32,921			33,848
19	63,977,851	32,951	49	64,979,717	33,880
20	64,010,802	32,981	50	65,013,597	33,912
21	64,043,783		51	65,047,509	
		33,011			33,944
22	64,076,794	33,041	52	65,081,453	33,976
23	64,109,835	33,072	53	65,115,429	34,008
24	64,142,907		54	65,149,437	
		33,102			34,041
25	64,176,009	33,132	55	65,183,478	34,073
26	64,209,141	33,163	56	65,217,551	34,105
27	64,242,304		57	65,251,656	
		33,193			34,138
28	64,275,497	33,224	58	65,285,794	34,170
29	64,308,721	33,255	59	65,319,964	34,203
30	64,341,976		60	65,354,167	

73 Degr.			73 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	65,354,167		30	66,395,690	
		34,235			35,243
1	65,388,402	34,268	31	66,430,933	35,278
2	65,422,670	34,300	32	66,466,211	35,313
3	65,456,970		33	66,501,524	
		34,333			35,348
4	65,491,303	34,366	34	66,536,872	35,383
5	65,525,669	34,399	35	66,572,255	35,418
6	65,560,068		36	66,607,673	
		34,432			35,453
7	65,594,500	34,465	37	66,643,126	35,488
8	65,628,965	34,498	38	66,678,614	35,523
9	65,663,463		39	66,714,137	
		34,531			35,558
10	65,697,994	34,564	40	66,749,695	35,594
11	65,732,558	34,598	41	66,785,289	35,629
12	65,767,156		42	66,820,918	
		34,631			35,664
13	65,801,787	34,665	43	66,856,582	35,700
14	65,836,452	34,698	44	66,892,282	35,736
15	65,871,150		45	66,928,018	
		34,732			35,771
16	65,905,882	34,765	46	66,963,789	35,807
17	65,940,647	34,799	47	66,999,596	35,843
18	65,975,446		48	67,035,439	
		34,833			35,879
19	66,010,279	34,867	49	67,071,318	35,915
20	66,045,146	34,901	50	67,107,233	35,951
21	66,080,047		51	67,143,184	
		34,935			35,987
22	66,114,982	34,969	52	67,179,171	36,023
23	66,149,951	35,003	53	67,215,194	36,060
24	66,184,954		54	67,251,254	
		35,037			36,096
25	66,219,991	35,071	55	67,287,350	36,132
26	66,255,062	35,105	56	67,323,482	36,169
27	66,290,167		57	67,359,651	
		35,140			36,206
28	66,325,307	35,174	58	67,395,857	36,242
29	66,360,481	35,209	59	67,432,099	36,279
30	66,395,690		60	67,468,378	

74 Degr.			74 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	67,468,378		30	68,574,239	
		36,316			37,459
1	67,504,694		31	68,611,698	
		36,353			37,498
2	67,541,047		32	68,649,196	
		36,390			37,537
3	67,577,437		33	68,686,733	
		36,427			37,577
4	67,613,864		34	68,724,310	
		36,464			37,617
5	67,650,328		35	68,761,927	
		36,501			37,656
6	67,686,829		36	68,799,583	
		36,539			37,696
7	67,723,368		37	68,837,279	
		36,576			37,736
8	67,759,944		38	68,874,915	
		36,613			37,776
9	67,796,557		39	68,912,791	
		36,651			37,816
10	67,833,208		40	68,950,607	
		36,689			37,856
11	67,869,897		41	68,988,463	
		36,726			37,897
12	67,906,623		42	69,026,360	
		36,764			37,937
13	67,943,387		43	69,064,297	
		36,802			37,977
14	67,980,189		44	69,102,274	
		36,840			38,018
15	68,017,029		45	69,140,292	
		36,878			38,058
16	68,053,907		46	69,178,350	
		36,916			38,099
17	68,090,823		47	69,216,449	
		36,954			38,140
18	68,127,777		48	69,254,589	
		36,993			38,181
19	68,164,770		49	69,292,770	
		37,031			38,222
20	68,201,801		50	69,330,992	
		37,069			38,263
21	68,238,870		51	69,369,255	
		37,108			38,304
22	68,275,978		52	69,407,559	
		37,147			38,345
23	68,313,125		53	69,445,904	
		37,185			38,387
24	68,350,310		54	69,484,291	
		37,224			38,428
25	68,387,534		55	69,522,719	
		37,263			38,470
26	68,424,797		56	69,561,189	
		37,302			38,511
27	68,462,099		57	69,599,700	
		37,341			38,553
28	68,499,440		58	69,638,253	
		37,380			38,595
29	68,536,820		59	69,676,848	
		37,419			38,637
30	68,574,239		60	69,715,485	

75 Degr.			75 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	69,715,485		30	70,894,564	
		38,679			39,984
1	69,754,164		31	70,934,548	
		38,721			40,029
2	69,792,885		32	70,974,577	
		38,763			40,074
3	69,831,648		33	71,014,651	
		38,805			40,119
4	69,870,453		34	71,054,770	
		38,847			40,165
5	69,909,300		35	71,094,935	
		38,890			40,210
6	69,948,190		36	71,135,145	
		38,932			40,256
7	69,987,142		37	71,175,401	
		38,975			40,302
8	70,026,117		38	71,215,703	
		39,018			40,347
9	70,065,135		39	71,256,051	
		39,061			40,393
10	70,104,196		40	71,296,444	
		39,104			40,439
11	70,143,300		41	71,336,883	
		39,147			40,485
12	70,182,447		42	71,377,358	
		39,190			40,532
13	70,221,637		43	71,417,900	
		39,233			40,578
14	70,260,870		44	71,458,478	
		39,277			40,625
15	70,300,147		45	71,499,103	
		39,320			40,671
16	70,339,467		46	71,539,774	
		39,363			40,718
17	70,378,830		47	71,580,492	
		39,407			40,765
18	70,418,237		48	71,621,257	
		39,451			40,812
19	70,457,688		49	71,662,069	
		39,495			40,859
20	70,497,183		50	71,702,928	
		39,539			40,906
21	70,536,722		51	71,743,834	
		39,583			40,953
22	70,576,305		52	71,784,787	
		39,627			41,000
23	70,615,932		53	71,825,787	
		39,671			41,048
24	70,655,603		54	71,866,835	
		39,715			41,095
25	70,695,318		55	71,907,930	
		39,760			41,143
26	70,735,078		56	71,949,073	
		39,804			41,191
27	70,774,882		57	71,990,264	
		39,849			41,239
28	70,814,731		58	72,031,503	
		39,894			41,287
29	70,854,625		59	72,072,790	
		39,939			41,335
30	70,894,564		60	72,114,125	

76 Degr.			76 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	72,114,125		30	73,377,167	
		41,383			42,888
1	72,155,508	41,432	31	73,420,055	42,940
2	72,196,940	41,480	32	73,462,995	42,992
3	72,238,420		33	73,505,987	
		41,529			43,045
4	72,279,949	41,578	34	73,549,032	43,097
5	72,321,527	41,627	35	73,592,129	43,150
6	72,363,154		36	73,635,279	
		41,676			43,203
7	72,404,830	41,725	37	73,678,482	43,255
8	72,446,555	41,774	38	73,721,737	43,309
9	72,488,329		39	73,765,046	
		41,823			43,362
10	72,530,152	41,873	40	73,808,408	43,415
11	72,572,025	41,922	41	73,851,823	43,468
12	72,613,947		42	73,895,291	
		41,972			43,522
13	72,655,919	42,022	43	73,938,813	43,576
14	72,697,941	42,072	44	73,982,389	43,629
15	72,740,013		45	74,026,018	
		42,122			43,683
16	72,782,135	42,172	46	74,069,701	43,738
17	72,824,307	42,222	47	74,113,439	43,792
18	72,866,529		48	74,157,231	
		42,273			43,846
19	72,908,802	42,323	49	74,201,077	43,901
20	72,951,125	42,374	50	74,244,978	43,955
21	72,993,499		51	74,288,933	
		42,425			44,010
22	73,035,924	42,476	52	74,332,943	44,065
23	73,078,400	42,527	53	74,377,008	44,120
24	73,120,927		54	74,421,128	
		42,578			44,175
25	73,163,505	42,629	55	74,465,303	44,231
26	73,206,134	42,681	56	74,509,534	44,286
27	73,248,815		57	74,553,820	
		42,732			44,342
28	73,291,547	42,784	58	74,598,162	44,398
29	73,334,331	42,836	59	74,642,560	44,454
30	73,377,167		60	74,687,014	

77 Degr.			77 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	74,687,014		30	76,047,374	
		44,510			46,262
1	74,731,524		31	76,093,636	
		44,566			46,323
2	74,776,090		32	76,139,959	
		44,622			46,384
3	74,820,712		33	76,186,343	
		44,679			46,446
4	74,865,391		34	76,232,789	
		44,735			46,507
5	74,910,126		35	76,279,296	
		44,792			46,568
6	74,954,918		36	76,325,864	
		44,849			46,630
7	74,999,767		37	76,372,394	
		44,906			46,692
8	750,446,73		38	76,419,186	
		44,964			46,754
9	75,089,637		39	76,465,940	
		45,021			46,816
10	75,134,658		40	76,512,756	
		45,079			46,879
11	75,179,737		41	76,559,635	
		45,136			46,941
12	75,224,873		42	76,606,576	
		45,194			47,004
13	75,270,067		43	76,653,580	
		45,252			47,067
14	75,315,319		44	75,700,647	
		45,310			47,130
15	75,360,629		45	76,747,777	
		45,369			47,193
16	75,405,998		46	76,794,970	
		45,427			47,256
17	75,451,425		47	76,842,226	
		45,486			47,320
18	75,496,911		48	76,889,546	
		45,545			47,384
19	75,542,456		49	76,936,930	
		45,604			47,448
20	75,588,060		50	76,984,378	
		45,663			47,512
21	75,633,723		51	77,031,890	
		45,722			47,576
22	75,679,445		52	77,079,466	
		45,781			77,641
23	75,725,226		53	77,127,107	
		45,841			47,705
24	57,771,067		54	77,174,812	
		45,901			47,770
25	75,816,968		55	77,222,582	
		45,961			47,835
26	75,862,929		56	77,270,417	
		46,021			47,900
27	75,908,950		57	77,318,317	
		46,081			47,966
28	75,955,031		58	77,366,283	
		46,141			48,031
29	76,001,172		59	77,414,314	
		46,202			48,097
30	76,047,374		60	77,462,411	

78 Degr.			78 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	77,462,411		30	78,936,821	
		48,163			50,230
1	77,510,574	48,229	31	78,987,051	50,302
2	77,558,803		32	79,037,353	
		48,295			50,374
3	77,607,098	48,362	33	79,087,727	50,447
4	77,655,460	48,428	34	79,138,174	50,519
5	77,703,888		35	79,188,693	
		48,495			50,592
6	77,752,383	48,562	36	79,239,285	50,665
7	77,800,945	48,629	37	79,289,950	50,739
8	77,849,574		38	79,340,689	
		48,697			50,812
9	77,898,271	48,764	39	79,391,501	50,886
10	77,947,035	48,832	40	79,442,387	50,960
11	77,995,867		41	79,493,347	
		48,900			51,034
12	78,044,767	48,968	42	79,544,381	51,108
13	78,093,735	49,037	43	79,595,489	51,183
14	78,142,772		44	79,646,672	
		49,105			51,258
15	78,191,877	49,174	45	79,697,930	51,333
16	78,241,051	49,243	46	79,749,263	51,408
17	78,290,294		47	79,800,671	
		49,312			51,484
18	78,339,606	49,382	48	79,852,155	51,559
19	78,388,988	49,451	49	79,903,714	51,635
20	78,438,439		50	79,955,349	
		49,521			51,712
21	78,487,960	49,591	51	80,007,061	51,788
22	78,537,551	49,661	52	80,058,849	51,865
23	78,587,212		53	80,110,714	
		49,731			51,942
24	78,636,943	49,802	54	80,162,656	52,019
25	78,686,745	49,873	55	80,214,675	52,096
26	78,736,618		56	80,266,771	
		49,944			52,174
27	78,876,592	50,015	57	80,318,945	52,252
28	78,836,577	50,086	58	80,371,197	52,330
29	78,886,663		59	80,423,527	
		50,158			52,408
30	78,936,821		60	80,475,935	

79 Degr.			79 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	80,475,935		30	82,085,813	
		52,486			54,960
1	80,528,421	52,565	31	82,140,773	55,046
2	80,580,986	52,644	32	82,195,819	55,133
3	80,633,630		33	82,250,952	
		52,724			55,220
4	80,686,354	52,803	34	82,306,172	55,308
5	80,739,157	52,883	35	82,361,480	55,395
6	80,792,040		36	82,416,875	
		52,963			55,483
7	80,845,003	53,043	37	82,472,358	55,571
8	80,898,046	53,124	38	82,527,929	55,660
9	80,951,170		39	82,583,589	
		53,204			55,749
10	81,004,374	53,285	40	82,639,338	55,838
11	81,057,659	53,367	41	82,695,176	55,927
12	81,111,026		42	82,751,103	
		53,448			56,017
13	81,164,474	53,530	43	82,807,120	56,107
14	81,218,004	53,612	44	82,863,227	56,197
15	81,271,616		45	82,919,424	
		53,694			56,288
16	81,325,310	53,777	46	82,975,712	56,378
17	81,379,087	53,859	47	83,032,090	56,470
18	81,432,946		48	83,088,560	
		53,943			56,561
19	81,486,889	54,026	49	83,145,121	56,653
20	81,540,915	54,109	50	83,201,774	56,745
21	81,595,024		51	83,258,519	
		54,193			56,837
22	81,649,217	54,277	52	83,315,356	56,930
23	81,703,494	54,362	53	83,372,286	57,023
24	81,757,856		54	83,429,309	
		54,446			57,116
25	81,812,302	54,531	55	83,486,425	57,210
26	81,866,833	54,616	56	83,543,635	57,304
27	81,921,449		57	83,600,939	
		54,702			57,398
28	81,976,151	54,788	58	83,658,337	57,492
29	82,030,939	54,874	59	83,715,829	57,587
30	82,085,813		60	83,773,416	

80 Degr.			80 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	83,773,416		30	85,546,774	
		57,682			60,694
1	83,831,098		31	85,607,468	
		57,778			60,799
2	83,888,876		32	85,668,267	
		57,874			60,906
3	83,946,750		33	85,729,173	
		57,970			61,012
4	84,004,720		34	85,790,185	
		58,066			61,119
5	84,062,786		35	85,851,304	
		58,163			61,227
6	84,120,949		36	85,912,531	
		58,260			61,335
7	84,179,209		37	85,973,866	
		58,358			61,443
8	84,237,567		38	86,035,209	
		58,455			61,551
9	84,296,022		39	86,096,860	
		58,553			61,660
10	84,354,575		40	86,158,520	
		58,652			61,770
11	84,413,227		41	86,220,290	
		58,751			61,879
12	84,471,978		42	86,282,169	
		58,850			61,989
13	84,530,828		43	86,344,158	
		58,949			62,100
14	84,589,777		44	86,406,258	
		59,049			62,211
15	84,648,826		45	86,468,469	
		59,149			62,322
16	84,707,975		46	86,530,791	
		59,250			62,434
17	84,767,225		47	85,593,225	
		59,350			62,546
18	84,826,575		48	86,655,771	
		59,452			62,658
19	84,886,027		49	86,718,429	
		59,553			62,771
20	84,945,580		50	86,781,200	
		59,655			62,885
21	85,005,235		51	86,844,085	
		59,757			62,999
22	85,064,992		52	86,907,084	
		59,860			63,113
23	85,124,852		53	86,970,197	
		59,962			63,227
24	85,184,815		54	87,033,424	
		60,066			63,342
25	85,244,881		55	87,096,766	
		60,170			63,458
26	85,305,051		56	87,160,224	
		60,274			63,574
27	85,365,325		57	87,223,798	
		60,378			63,690
28	85,425,703		58	87,287,488	
		60,483			63,807
29	85,486,186		59	87,351,295	
		60,588			63,924
30	85,546,774		60	87,415,219	

81 Degr.			81 Degr.		
Min	Equal parts of a meridian. &c.	Difference of equal parts.	Min	Equal parts of a meridian. &c.	Difference of equal parts.
0	87,415,219		30	89,389,688	
		64,042			67,786
1	87,479,261		31	89,457,474	
		64,160			67,919
2	87,543,421		32	89,525,393	
		64,278			68,052
3	87,607,699		33	89,593,445	
		64,397			68,185
4	87,672,096		34	89,661,630	
		64,517			68,319
5	87,736,613		35	89,729,949	
		64,636			68,454
6	87,801,249		36	89,798,403	
		64,757			68,589
7	87,866,006		37	89,866,992	
		64,877			68,724
8	87,930,883		38	89,935,716	
		64,999			68,861
9	87,995,882		39	90,004,577	
		65,120			68,997
10	88,061,002		40	90,073,574	
		65,242			69,135
11	88,126,244		41	90,142,709	
		65,365			69,273
12	88,191,609		42	90,211,982	
		65,488			69,411
13	88,257,097		43	90,281,393	
		65,612			69,550
14	88,322,709		44	90,350,943	
		65,736			69,689
15	88,388,445		45	90,420,632	
		65,860			69,830
16	88,454,305		46	90,490,462	
		65,985			69,970
17	88,520,290		47	90,560,432	
		66,110			70,111
18	88,586,400		48	90,630,543	
		66,236			70,253
19	88,652,636		49	90,700,796	
		66,363			70,396
20	88,718,999		50	90,771,192	
		66,490			70,539
21	88,785,489		51	90,841,731	
		66,617			70,682
22	88,852,106		52	90,912,413	
		66,745			70,826
23	88,918,851		53	90,983,239	
		66,873			70,971
24	88,985,724		54	91,054,210	
		67,002			71,117
25	89,052,726		55	91,125,327	
		67,132			71,263
26	89,119,858		56	91,196,590	
		67,261			71,409
27	89,187,119		57	91,267,999	
		67,392			71,556
28	89,254,511		58	91,339,555	
		67,523			71,704
29	89,322,034		59	91,411,159	
		67,654			71,852
30	89,389,688		60	91,483,111	

82 Degr.			82 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	91,483,111	72,001	30	93,710,914	76,782
1	91,555,113	72,151	31	93,787,706	76,953
2	91,627,264	72,301	32	93,864,659	77,124
3	91,699,565	72,452	33	93,941,783	77,296
4	91,772,017	72,604	34	94,019,079	77,468
5	91,844,621	72,756	35	94,096,547	77,642
6	91,917,377	72,909	36	94,174,189	77,816
7	91,990,286	73,062	37	94,252,005	77,991
8	92,063,348	73,217	38	94,329,996	78,167
9	92,136,565	73,371	39	94,408,163	78,344
10	92,209,936	73,527	40	94,486,507	78,521
11	92,283,463	73,683	41	94,565,028	78,700
12	92,357,146	73,840	42	94,643,728	78,879
13	92,430,986	73,997	43	94,722,607	79,059
14	92,504,983	74,155	44	94,801,666	79,239
15	92,579,138	74,314	45	94,880,905	79,421
16	92,653,452	74,474	46	94,960,326	79,603
17	92,727,926	74,634	47	95,039,929	79,787
18	92,802,560	74,795	48	95,119,716	79,971
19	92,877,355	74,957	49	95,199,687	80,156
20	92,952,312	75,119	50	95,279,843	80,342
21	93,027,431	75,282	51	95,360,185	80,529
22	93,102,713	75,446	52	95,440,714	80,716
23	93,178,159	75,610	53	95,521,430	80,905
24	93,253,769	75,775	54	95,602,335	81,094
25	93,329,544	75,941	55	95,683,429	81,284
26	93,405,485	76,108	56	95,764,713	81,475
27	93,481,593	76,275	57	95,846,189	81,668
28	93,557,868	76,444	58	95,927,857	81,861
29	93,634,312	76,612	59	96,009,718	82,055
30	93,710,914		60	96,091,773	

83 Degr.			83 Degr.		
Min.	Equal parts of a meridian. &c.	Difference of equal parts.	Min.	Equal parts of a meridian. &c.	Difference of equal parts.
0	96,091,773		30	98,648,445	
		82,249			88,562
1	96,174,022		31	98,737,007	
		82,445			88,790
2	96,256,467		32	98,825,797	
		82,642			89,018
3	96,339,009		33	98,914,815	
		82,840			89,248
4	96,421,949		34	99,004,063	
		83,038			89,479
5	96,504,987		35	99,093,542	
		83,238			89,711
6	96,588,225		36	99,183,253	
		83,439			89,944
7	96,671,664		37	99,273,197	
		83,640			90,178
8	96,755,304		38	99,363,375	
		83,843			90,414
9	96,839,147		39	99,453,789	
		84,046			90,651
10	96,923,193		40	99,544,440	
		84,251			90,889
11	97,007,444		41	99,635,329	
		84,456			91,129
12	97,091,900		42	99,726,458	
		84,663			91,369
13	97,176,563		43	99,817,827	
		84,870			91,611
14	97,261,433		44	99,909,438	
		85,079			91,855
15	97,346,512		45	100,001,293	
		85,288			92,099
16	97,431,800		46	100,093,392	
		85,499			92,345
17	97,517,299		47	100,185,737	
		85,711			92,593
18	97,603,010		48	100,278,330	
		85,924			92,841
19	97,688,934		49	100,371,171	
		86,137			93,091
20	97,775,071		50	100,464,262	
		86,352			93,342
21	97,861,423		51	100,557,604	
		86,568			93,595
22	97,947,991		52	100,651,199	
		86,785			93,849
23	98,034,776		53	100,745,048	
		87,004			94,105
24	98,121,780		54	100,839,153	
		87,223			94,361
25	98,209,003		55	100,933,514	
		87,443			94,620
26	98,296,446		56	101,028,134	
		87,665			94,879
27	98,384,111		57	101,123,013	
		87,887			95,141
28	98,471,998		58	101,218,154	
		88,111			95,403
29	98,560,109		59	101,313,557	
		88,336			95,667
30	98,648,445		60	101,409,224	

84 Degr.			84 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	101,409,224		30	104,409,799	
		95,933			104,650
1	101,505,157		31	104,514,449	
		96,200			104,968
2	101,601,357		32	104,619,417	
		96,468			105,288
3	101,697,825		33	104,724,705	
		96,738			105,610
4	101,794,563		34	104,830,315	
		97,010			105,934
5	101,891,573		35	104,936,249	
		97,283			106,260
6	101,988,856		36	105,042,509	
		97,557			106,588
7	102,086,413		37	105,149,097	
		97,834			106,918
8	102,184,247		38	105,256,015	
		98,111			107,250
9	102,282,358		39	105,363,265	
		98,391			107,584
10	102,380,749		40	105,470,849	
		98,672			107,921
11	102,479,421		41	105,578,770	
		98,954			108,259
12	102,578,375		42	105,687,029	
		99,238			108,600
13	102,677,613		43	105,795,629	
		99,524			108,942
14	102,777,137		44	105,904,571	
		99,812			109,287
15	102,876,949		45	106,013,858	
		100,101			109,634
16	102,977,050		46	106,123,492	
		100,392			109,984
17	103,077,442		47	106,233,476	
		100,684			110,335
18	103,178,126		48	106,343,811	
		100,979			110,689
19	103,279,105		49	106,454,500	
		101,275			111,045
20	103,380,380		50	106,565,545	
		101,572			111,403
21	103,481,952		51	106,676,948	
		101,872			111,764
22	103,583,824		52	106,788,712	
		102,173			112,127
23	103,685,997		53	106,900,839	
		102,476			112,493
24	103,788,473		54	107,013,332	
		102,781			112,861
25	103,891,254		55	107,126,193	
		103,088			113,231
26	103,994,342		56	107,239,424	
		103,397			113,604
27	104,097,739		57	107,353,128	
		103,707			113,979
28	104,201,446		58	107,467,107	
		104,019			114,356
29	104,305,465		59	107,581,463	
		104,334			114,737
30	104,409,799		60	107,696,200	

85 Degr.			85 Degr.		
Min.	Equal parts of a meridian. &c.	Difference of equal parts.	Min.	Equal parts of a meridian &c.	Difference of equal parts.
0	107,696,200		30	111,328,728	
		115,119			127,927
1	107,811,319		31	111,456,655	
		115,505			128,404
2	107,926,824		32	111,585,059	
		115,893			128,884
3	108,042,717		33	111,713,943	
		116,283			129,367
4	108,159,002		34	111,843,310	
		116,676			129,854
5	108,275,678		35	111,973,164	
		117,072			130,345
6	108,392,750		36	112,103,509	
		117,471			130,840
7	108,510,221		37	112,234,349	
		117,872			131,338
8	108,628,093		38	112,365,687	
		118,276			131,841
9	108,746,369		39	112,497,528	
		118,683			132,347
10	108,865,052		40	112,629,875	
		119,093			132,857
11	108,984,145		41	112,762,732	
		119,506			133,371
12	109,103,651		42	112,895,803	
		119,921			133,889
13	109,223,572		43	113,029,992	
		120,339			134,411
14	109,343,911		44	113,164,403	
		120,760			134,937
15	109,464,671		45	113,299,340	
		121,185			135,467
16	109,585,856		46	113,434,807	
		121,612			136,002
17	109,707,468		47	113,570,809	
		122,042			136,540
18	109,829,510		48	113,707,349	
		122,476			137,083
19	109,951,986		49	113,844,432	
		122,912			137,631
20	110,074,898		50	113,982,063	
		123,352			138,183
21	110,198,250		51	114,120,246	
		123,794			138,739
22	110,322,044		52	114,258,685	
		124,240			139,299
23	110,445,628		53	114,398,284	
		124,989			139,865
24	110,570,973		54	114,538,149	
		125,142			140,435
25	110,696,115		55	114,678,584	
		125,598			141,009
26	110 821,713		56	114,819,593	
		126,057			141,588
27	110,947,770		57	114,961,181	
		126,519			142,172
28	111,074,289		58	115,103,353	
		126,985			142,761
29	111,201,274		59	115,246,114	
		127,454			143,355
30	111,328,728		60	115,389,469	

86 Degr.			86 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	115,389,469		30	119,993,436	
		143,954			164,586
1	115,533,423		31	120,158,022	
		144,558			165,377
2	115,677,981		32	120,323,399	
		145,167			166,175
3	115,823,148		33	120,489,574	
		145,781			166,980
4	115,968,929		34	120,656,554	
		146,401			167,794
5	116,115,330		35	120,824,348	
		147,025			168,615
6	116,262,355		36	120,992,963	
		147,655			169,445
7	116,410,010		37	121,162,408	
		148,291			170,283
8	116,558,001		38	121,332,691	
		148,932			171,129
9	116,707,233		39	121,503,820	
		149,578			171,984
10	116,856,811		40	121,675,804	
		150,230			172,847
11	117,007,041		41	121,848,651	
		150,883			173,719
12	117,157,929		42	122,022,370	
		151,552			174,600
13	117,309,481		43	122,196,970	
		152,222			175,490
14	117,461,703		44	122,372,460	
		152,897			176,389
15	117,614,600		45	122,548,849	
		153,579			177,297
16	117,768,179		46	122,726,146	
		154,267			178,215
17	117,922,446		47	122,904,361	
		154,961			179,142
18	118,077,407		48	123,083,503	
		155,661			180,078
19	118,233,068		49	123,263,581	
		156,367			181,025
20	118,389,435		50	123,444,608	
		157,080			181,983
21	118,546,515		51	123,626,589	
		157,800			182,950
22	118,704,315		52	123,809,539	
		158,526			183,927
23	118,862,841		53	123,993,466	
		159,259			184,915
24	119,022,100		54	124,078,381	
		159,999			185,913
25	119,182,099		55	124,264,294	
		160,746			186,923
26	119,342,845		56	124,451,217	
		161,499			187,943
27	119,504,344		57	124,639,160	
		162,260			188,975
28	119,666,604		58	124,828,135	
		163,028			190,018
29	119 829,632		59	125,018,153	
		163,804			191,073
30	119,993,436		60	125,209,226	

87 Degr.			87 Degr.		
Min.	Equal parts of a meridian. &c.	Difference of qual parts.	Min.	Equal parts of a meridian. &c.	Difference of qual parts.
0	125,209,226	192,139	30	131,498,494	230,793
1	125,401,365	193,218	31	131,729,287	232,351
2	125,594,583	194,308	32	131,961,638	233,936
3	125,788,891	195,411	33	132,195,574	235,532
4	125,984,102	196,527	34	132,431,106	237,156
5	126,180,829	197,656	35	132,668,262	238,802
6	126,378,485	198,797	36	132,907,064	240,470
7	126,577,282	199,952	37	133,147,534	242,163
8	126,777,234	201,120	38	133,389,697	243,880
9	126,978,354	202,302	39	133,633,577	245,621
10	127,180,656	203,498	40	133,879,198	247,387
11	127,384,154	204,709	41	134,126,585	249,178
12	127,588,863	205,934	42	134,375,763	250,996
13	127,794,797	207,173	43	134,626,759	252,841
14	128,001,970	208,428	44	134,879,600	154,713
15	128,210,398	209,698	45	135,134,313	256,613
16	128,420,096	210,983	46	135,390,926	258,541
17	128,631,079	212,285	47	135,649,467	260,499
18	128,843,364	213,602	48	135,909,966	262,486
19	129,056,966	214,936	49	136,172,452	264,505
20	129,271,902	216,287	50	136,436,957	266,554
21	129,488,189	217,655	51	136,703,511	268,636
22	129,705,841	219,040	52	136,972,147	270,750
23	129,924,884	220,444	53	137,242,897	272,898
24	130,145,328	221,865	54	137,515,795	275,080
25	130,367,193	223,304	55	137,790,875	277,297
26	130,590,497	224,763	56	138,068,172	279,551
27	130,815,260	226,241	57	138,347,723	281,841
28	131,041,501	227 738	58	138,629,564	284,169
29	131,269 239	229,255	59	138,913,733	286,537
30	131,493,494		60	139 200,270	

88 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	139,200,270	288,943
1	139,489,213	291,391
2	139,780,604	293,881
3	140,074,485	296,413
4	140,370,898	298,990
5	140,669,888	301,612
6	140,971,500	304,281
7	141,275,781	306,995
8	141,582,776	309,760
9	141,892,536	312,575
10	142,205,111	315,442
11	142,520,553	318,361
12	142,838,914	321,336
13	143,160,250	324,367
14	143,484,617	327,455
15	143,812,072	330,602
16	144,142,674	333,811
17	144,476,485	337,083
18	144,813,568	340,419
19	145,153,987	343,823
20	145,497,810	347,295
21	145,845,105	350,838
22	146,195,943	354,453
23	146,550,396	358,145
24	146,908,541	361,914
25	147,270,455	365,763
26	147,636,218	369,695
27	148,005,913	373,712
28	148,379,625	377,818
29	148,757,443	382,015
30	149,139,458	

88 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.
30	149,139,458	386,306
31	149,525,764	390,695
32	149,916,459	395,185
33	150,311,644	399,779
34	150,711,423	404,482
35	151,115,905	409,296
36	151,525,201	414,226
37	151,939,427	419,277
38	152,358,704	424,452
39	152,783,156	429,752
40	153,212,913	435,196
41	153,648,109	440,774
42	154,088,883	446,497
43	154,535,380	452,371
44	154,987,751	458,402
45	155,446,153	464,596
46	155,910,749	470,959
47	156,381,708	477,499
48	156,859,207	484,224
49	157,343,431	491,140
50	157,834,571	498,257
51	158,332,828	505,583
52	158,838,411	513,129
53	159,351,540	520,902
54	159,872,442	528,915
55	160,401,357	537,178
56	160,938,535	545,704
57	161,484,239	554,505
58	162,038,744	563,594
59	162,602,338	572,986
60	163,175,324	

89 Degr.			89 Degr.		
Min.	Equal parts of a meridian, &c.	Difference of equal parts.	Min.	Equal parts of a meridian, &c.	Difference of equal parts.
0	163,175,324		30	187,293,467	
		582,696			1,185,443
1	163,758,020		31	188,478,910	
		592,743			1,227,780
2	164,350,763		32	189,706,690	
		603,141			1,273,252
3	164,953,904		33	190,979,942	
		613,910			1,322,222
4	165,567,814		34	192,302,164	
		625,071			1,375,110
5	166,192,885		35	193,677,274	
		636,645			1,432,406
6	166,829,530		36	195,109,680	
		648,657			1,494,683
7	167,478,187		37	196,604,363	
		661,130			1,562,622
8	168,139,317		38	198,166,985	
		674,092			1,637,032
9	168,813,409		39	199,804,017	
		687,573			1,718,883
10	169,500,982		40	201,522,900	
		701,604			1,809,349
11	170,202,586		41	203,332,249	
		716,220			1,909,868
12	170,918,805		42	205,242,117	
		731,458			2,022,212
13	171,650,264		43	207,264,329	
		747,358			2,148,599
14	172,397,622		44	209,412,928	
		763,965			2,291,838
15	173,161,587		45	211,704,766	
		781,327			2,455,540
16	173,942,914		46	214,160,306	
		799,496			2,644,426
17	174,742,410		47	216,804,732	
		818,531			2,864,794
18	175,560,941		48	219,669,526	
		838,494			3,125,229
19	176,399,435		49	222,794,755	
		859,456			3,437,751
20	177,258,891		50	226,232,506	
		881,492			3,819,723
21	178,140,383		51	230,052,229	
		904,688			4,297,187
22	179,045,071		52	234,349,416	
		929,138			4,911,090
23	179,974,209		53	239,260,506	
		954,947			5,729,580
24	180,929,156		54	244,990,086	
		982,230			6,875,496
25	181,911,386		55	251,865,582	
		1,011,118			8,594,338
26	182,922,504		56	260,459,920	
		1,041,757			11,459,157
27	183,964,261		57	271,919,077	
		1,074,311			17,188,734
28	185,038,572		58	289,107,811	
		1,108,965			34,377,468
29	186,147,537		59	323,485,279	
		1,145,930			*Infinite.*
30	187,293,467		60	*Infinite.*	

Chap. III.

The vse of the two first columnes of the Table of Latitudes, for graduating a meridian in the general Sea-Chart.

BEfore you can make vse of this Table, for the true graduating, or diuiding of a meridian of this Chart into his degrees, or other parts of Latitude, increasing from the æquinoctial towards the North and South in such proportion, as before hath been shewed, there must be first some preparation made to that end; which may be done after this manner: Ouerthwart the midst of the plaine superficies, whereupon you will draw the lineaments of the Chart, describe a right line, (representing the æquinoctial circle) which you shall diuide into 360 parts or degrees, and crosse the same squirewise with right lines, by euery fift or tenth degree. Then take with your compasses the length of halfe the æquinoctial, (that is, 180 degrees) and setting one foote of your compasses in the mutuall intersection of the æquinoctial, with the perpendicular or meridian that passeth by either end of the æquinoctial, with the other foote make a pricke in the same perpendicular or meridian: the space conteined betwixt this pricke and the æquinoctial, diuide first into three æquall parts, and euery one of these into other three, so haue you nine in all: and againe

euery

euery one of these into three, so haue you 27 partes, and euery one of these parts diuide into foure, so haue you 108 parts: And againe (if there be space enough) diuide euery one of these into 10 or 100. so shall you haue 1080, or 10800 parts, which will bring you to the Latitude of 85 degrees and something more. But if you would make your Chart to any greater Latitude, you shall continue forth the foresaid perpendicular, and diuide it into so manie more of the same partes as you shall find needfull to attaine to the Latitude you desire. Then note euerie fift and tenth part with black leade, and set figures at them, beginning at the æquinoctial, and from thence proceeding Northwards and Southwardes.

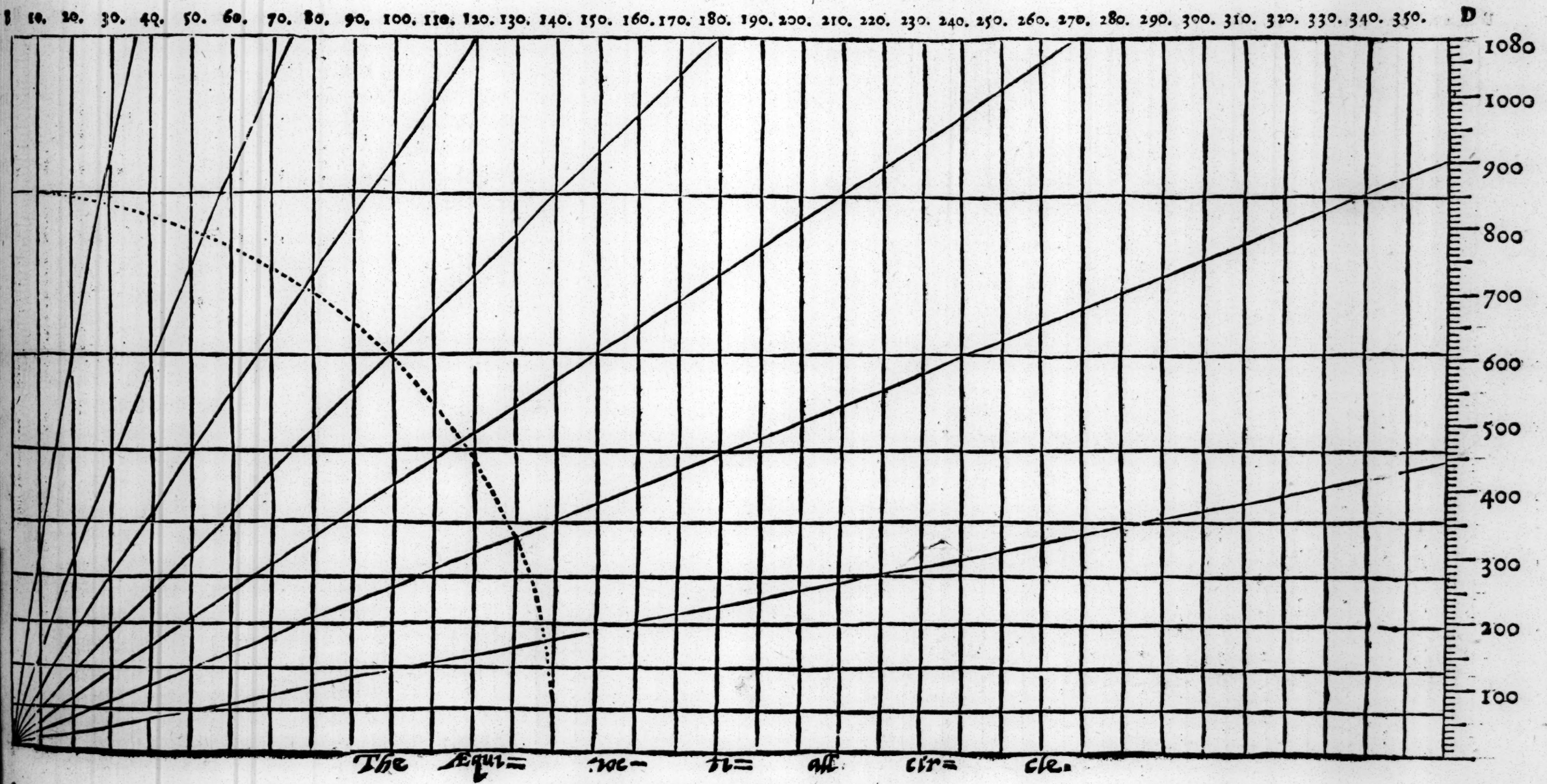
The vse of the two first columnes of the table of Latitudes.

Then looke what numbers in the second columne are answerable to each degree, or minute in the first columne of this table of Latitudes (omitting alwaies foure or fiue of the first figures towardes the right hand) and at the same numbers of parts in the perpendiculars, make pricks on either side the æquinoctial: by which (prickes) draw right lines equidistant from the æquinoctial, for they shall be the parallels of the true nautical Planisphære, or Sea-chart.

Notwithstanding these parallels are all of them a little further distant from the æqninoctial then in trueth they should bee: and so much the more, the further they are from the æquinoctial. Which error might be something the lesse, if the former Table had been first made to smaller partes then minutes. But that were a matter more curious then necessarie, the table here before set downe being so neere the trueth, that it is not possible by any rules

or

The draught of the Meridians, Parallels, and Rumbes of the nautical Planisphære truly made.



A

Place this betweene H and I, pag. 115.

C

The vſe of the two firſt columnes of the table of Latitudes.

or instruments of Nauigation, to discouer any sensible error in the Sea-chart, so farre foorth as it shall be made according thereto.

Example of the graduating of a meridian in the generall sea-chart.

The figure following containeth onely one part of the nauticall Planisphære, from the æquinoctiall Northwards, because the other part from the æquinoctiall Southwards must be altogether like and equall to this. Herein first I drew the æquinoctiall line A C, and diuided it into 36 equall parts, whereof euery one is vnderstood to conteine ten degrees, and I raised perpendiculars from euery one of those parts; which are the meridians of the Nauticall Planisphære, euery where æquidistãt each from other. Then I tooke halfe the length of the æquinoctiall with the compasses, and setting one foote in the end of the æquinoctial at C, with the other foot I made a pricke at D in the perpendicular or meridian C D. The space contained betwixt C and D, I diuided into 1080 parts, (vnderstanding euery one of the smaller parts, or segments of the line C D to conteine ten lesser parts) in such sort as before hath been shewed, and set figures to them, as here you see, for the readier numbring & finding out of any of those parts. Then I looked in the former table what number of equall parts of the meridian answered to euerie tenth degree, and (casting away fiue of the first figures next the right hand (because I conceiue the space betwixt C and D to be diuided only into 1080 parts) I found out the parts answerable to the numbers remaining in the line C D: and at those parts I made prickes, by which I drew the parallels.

As for example: in the table, the number answerable to ten degrees, is 60, casting away the fiue first figures towards the right hand: therefore I looke 60 in the line C D, and by that part I draw the parallel of ten degrees distance from the equinoctiall. Likewise the number answering to twentie degrees (omitting the fiue first figures) is 122: therefore by that number of equall parts I draw the parallel of twentie degrees latitude from the equinoctiall, &c. And after this manner I drew all the rest, as you may see in the former draught.

Chap. IIII.

Another way for graduating the meridian of a generall Sea-chart.

Therwise for the diuiding of the meridian of a general Sea-chart into his degrees, and other smaller parts of latitude, when the Chart hath not so great latitude or breadth frō the equinoctiall towards the North or South, as hath the figure before set downe; you may go thus to work: First finde out what proportion the whole longitude (or length of the Chart from West to East) must haue to the whole breadth thereof betwixt the parallels of the most Northerly and Southerly places, that are to be set downe therein: which may be done after this manner: Out of the second columne of the table of Latitudes, take the numbers of equall

equall parts of the meridian answerable to the greatest North and South latitudes that are to bee set downe in the Chart: diuide those numbers by 600,000 (that is the number of equall parts of the meridian answerable to one degree of the equinoctiall) the quotients will shew how many degrees of the equinoctiall the breadth of the Chart must be on either side the equinoctiall toward the North and South. As for example, in the generall Sea-chart to be adioyned to this booke, the latitude of the North part of the New land, found by the Hollanders about the yeere 1596, and by them called *Gebroncken land* (lying Northwards from *Norway*) is about 80 degrees. And the latitude of Queene *Elizabeths* Iland (first found by Sir *Francis Drake*, lying to the Southwards of Magellanes streights) is about 53 degrees. The numbers of equall parts of the meridian answerable to these latitudes, found out in the foresaid *Table of Latitudes* are 83,773,416, and 37,639,370; which being diuided by 600,000, the quotients are 140 and 63 almost, shewing ỹ breadth of the Chart from the equinoctiall Northwards and Southwards, in such parts whereof the equinoctiall conteineth 360; which added together shal shew that the whole breadth of the Chart from North to South must be about 203 such parts.

Hauing therefore diuided the length of the equinoctiall or any other parallel of the Chart (becausse they are all equall) into 360 parts, take with a paire of compasses 210 of the same parts (becausse that is the next greater number apt for diuision) & so keeping them vnaltered, set both feete in the meridian

at one of the ends, or in the middeſt of the Chart, and diuide the ſpace conteined betweene them firſt into ſeuen parts, and euery one of them into three, ſo haue you 21 in all: then diuide each of theſe into two, and theſe againe into fiue; ſo ſhall you haue in all 210, the number of the parts required. Now beginning at the Southermoſt of theſe parts, tell on Northwards, till you come to 66, and thereby draw the æquinoctial ouerthwart the meridian at right angles. After this you may diuide the ſaid parts of the meridian euery one into ſix, drawing foorth euerie fifth or tenth, a little further then the reſt, and ſetting figures to euery hundreth part, for the readier finding out of any number of thoſe parts that ſhall bee required. This being done, the meridian may be diuided into his degrees of latitude, and the parallels drawne after the ſame manner that wee haue alreadie ſhewed for the drawing of the former figure of a generall Sea-chart, in the Chapter next going before.

Chap. V.

The vſe of the table of Latitudes for the true graduating of a particular Sea-chart.

TO make a particular Sea-chart, firſt conſider at what latitudes your Chart muſt begin and end: Then looke in the former table of Latitudes what numbers of equall parts are anſwerable to both thoſe latitudes, and ſubtract the equall parts anſwering to the leſſer latitude, out of ỹ equal parts anſwerable to the greater latitude; and drawing a line ouerthwart the breadth

breadth of the Chart from North to South (at one of the ends, or in ſome other vacant place thereof) diuide the ſame line into ſo many equall parts, as the difference remaining ſhall amount vnto: if that difference bee a compound number that may be diuided into his vnities by ſmall diuiſors. But if it fall out that the number of equal parts remaining be either a prime number, or elſe ſuch a number as cannot otherwiſe be diuided into his vnities, but by ſome great diuiſors, you may then take the next compound number that is greater then the ſaid difference, which may bee diuided into his vnities by ſmall diuiſors. Thus hauing diuided ẏ line drawne ouerthwart the breadth of the Chart, into ſo many equall parts, as this compound number containeth vnities, and beginning at that end thereof which is ſuppoſed to bee Southwards, or next the equinoctiall, ſet thereto the next number of whole hundreths, or thouſands, leſſe then the number of equal parts anſwerable to the leſſer latitude, and drawing foorth euery fifth, or tenth part, a little further then the reſt, ſet figures to euery tenth, hundreth, or thouſandth part, that you may readily number and find out any of them.

Then looke in the table of Latitudes which of theſe equall parts anſwere to each degree or half degree, or each tenth minute of latitude (if your Chart be of a very large prick) and with the point of your penne or compaſſes make marks there, and ſo finiſh the graduation of the meridian of your Chart after the accuſtomed manner before ſhewed in the former Chapter.

Example. As for example: in the particular Chart for the Azores hereunto adioyned, the leaſt latitude is 36 degrees 10 minutes; the greateſt 52 degrees 20 minutes; the equall parts anſwerable to theſe in the table of Latitudes, (caſting away the foure firſt figures towards the right hand) are 2330 for the firſt, and 3698 for the ſecond latitude. The difference of theſe is 1368. Then at the Weſt end of the Chart I draw the line A B ſomething longer then ŷ breadth of the Chart which I purpoſe to make, and diuide it into 1400 parts, ſuppoſing euery one of thoſe ſmalleſt parts to ſtand for two. And this I doe by diuiding the whole line firſt into two parts, and each of theſe againe into ſeuen; ſo haue you 14 parts in all, whereof euery one muſt bee vnderſtood to be diuided into 100 equall parts after the ordinarie maner, firſt diuiding each of them into two parts, then euery one of thoſe into fiue, and theſe againe euery one into fiue parts, &c.

Now becauſe the leaſt latitude in this Chart beginneth at 2330 equall parts, I do therefore account the beginning of the line A B at A to be at 2300, and ſo proceed ſetting down numbers at euery 100 part, as in that Chart you may ſee.

Now for graduating the meridian that is adioyning, or rather all one with the line A B, you may proceed in like ſort, as before was ſhewed, for the making of a generall Sea-chart in the third chapter: looking what number of equall parts anſwer to each degree in the table of Latitudes; and at the ſame number of equall parts in the Chart, making marks ſignifying thoſe degrees, &c. As for example: In the

the table I finde anſwerable to 37 degr. 0 min. 2393, (caſting away the foure firſt figures next the right hand) therefore at the ſame number of equall parts in the line A B in the Chart, I draw forth the line of 37 degrees latitude. In like manner, at 2468 equall parts in the Chart I ſet downe 38 degrees, becauſe in the table of Latitudes I finde that number anſwerable to 38 degrees: And at 2545 I ſet 39 degrees. And ſo forth for all the reſt.

In like ſort you may out of the table of Latitudes ſet downe euery tenth or fifth minute into this Chart; or elſe (which is alſo ſomething eaſier, and not altogether ſo tedious) you may with a paire of compaſſes diuide each degree in the Chart into 12 equall parts. In which diuiſion, although indeede there will be ſome error; yet in this particular chart, or others not much exceeding this in the greatneſſe either of the latitude, or of the degrees thereof, that error will bee ſo ſmall, as that by ſenſe it can either not at all, or very hardly be diſcerned.

Chap. VI.

The breadth of a particular Chart being giuen, to diuide the ſame into the degrees and minutes conteined in the difference of the leaſt and greateſt latitudes therein to be expreſſed.

BVt if you would make your Chart to a certeine breadth limited, which you alſo deſire to diuide vnequally in due proportion (as hath been ſhewed) into the number of degrees and minutes conteined between the leaſt and greateſt

teſt latitudes which you would haue therein ſet downe: you may then goe thus to worke: Draw a line equall to the breadth of the Chart (as for example, the line C D at the Eaſt end of ỹ particular Chart for the Azores) from the South end hereof draw another line ſomething longer, making an angle therewith of ſome 20 or 30 degrees, or thereabouts, as the line C E: And hauing found out (as before in the former chapter) the number of equall parts anſwerable to the difference of the leaſt and greateſt latitudes, (as the number of 1368) diuide this line C E into ſome compound number of parts that may bee diuided by ſmall diuiſors; (that compound number exceeding the number of thoſe equall parts ſo little as conueniently may be) as into 1400. In this line, beginning from the angle at C, tell out the ſaid number of equall parts 1368, from thence draw the baſe of that angle to the end of the firſt line (as the line F D:) for parallels to this baſe, drawne by the diuiſions of the ſecond line C E, ſhal diuide the firſt line C D (that meaſureth the breadth of the Chart) into the number of equall parts anſwerable to the difference of the leaſt and greateſt latitude in the Chart. But becauſe the drawing of ſo many parallels would not onely be troubleſome and tedious, but may alſo ſomething deface the Chart; it will be better to draw parallels by ſome few principall compound numbers of parts in the ſecond line, as by euery 100 or 1000 & to ſubdiuide with the cõpaſſes the ſegments of the firſt line conteined between thoſe parallels, as in this particular Chart you may ſee. Thus hauing diuided ỹ breadth

of

of the Chart into the number of parts required, and beginning at C the South end thereof to tell 2330, (which is the number of equall parts anſwerable to the leaſt latitude purpoſed to bee ſet downe in the Chart) tell on Northwards till you come to make vp an euen hundreth (as till you come to 2400) and there begin to ſet figures, ſhewing the number of the parts; and ſo proceed, ſetting figures to euerie hundreth part, and finiſhing the graduation of the meridian or diuiſion thereof into his vnequall parts in due proportion, as before you were directed in the former chapter.

CHAP. VII.

The vſe of the third columne of the table of Latitudes.

THE third columne being nothing elſe but the table of Secants, in ſuch parts whereof the whole ſine or ſemidiameter of the circle is ſuppoſed to conteine 10,000, may ſerue for all ſuch purpoſes for which the table of Secants may bee vſed. Moreouer, as it ſerued for the making of the ſecond columne of the table of Latitudes, as before is ſhewed in the ſecond chapter, page 17 and 18, ſo may it be of needfull vſe for the more eaſie examination and correction thereof, if any error hath been committed therein. First vſe. Second vſe.

Hereby alſo may bee knowne very exactly the proportion of any parallel to the equinoctiall. For what proportion the difference anſwerable to any degree and minute in this table hath to 10,000, the ſame Third vſe.

ſame proportion hath the equinoctiall to the parallel anſwering to that degree and minute: (The difference anſwerable to any degree and minute is that which is placed next aboue the line of the ſame minute:) And conſequently, becauſe the like parts of circles are proportional to their wholes, you may hereby very eaſily and truly finde out how many leagues any arch of any parallel conteineth: for as the difference anſwerable to the latitude of the parallel is to 10,000, ſo are the minutes conteined in that arch to the miles thereof; which diuided by 3, giue the leagues.

As for example, if you would know how many leagues make a degree in the parallel of *London*, whoſe latitude is 51 degrees 32 minutes: as 16,075 the difference anſwering to that latitude page 74 is to 10,000, ſo is 20 (the number of leagues conteined in one degree of the equinoctiall) to 12 $\frac{284}{643}$ the number of leagues making one degree in the parallel of *London*. Thus the difference of longitude in any parallel being giuen in degrees, may eaſily be reduced into leagues, multiplying the ſame by the leagues conteined in one degree. But it may be done eaſlier by multiplying the difference of longitude (reduced into minutes) by 10,000, and diuiding the product by the difference of equall parts (in the table of latitudes) anſwerable to the latitude of the parallel wherein that difference of longitude is taken; for then the quotient ſheweth the miles in the difference of longitude, which being diuided by 3, you haue the leagues.

An eaſie way to reduce the difference of longitude into leagues.

As for example: admit the difference of longitude

tude betweene the *Lizard* and *Fayal* be 22 degrees 52 minutes, that is 1372 minutes, which multiplied by 10,000, make 13,720,000: and this diuided by 12,898 (which is the difference of the equall parts answerable to 39 degrees 10 minutes, the lat. of the Northeast corner of *Fayal* Iland) shall giue you 1064 miles almost, that is 354 $\frac{2}{3}$ leagues, the difference of their longitudes counted in the parallel of *Fayal*.

Moreouer, by the differences set downe in the third columne may easily be found the sine of any arch of the quadrant: For as the difference answerable to any arch, or number of degrees and minutes in this table is to 10,000; so is 10,000 to the sine of the same arch. Fourth vse.

The demonstration hereof may easily be conceiued out of the Diagramme set down in the second chapter, pag. 16, wherein *ik* to *fk*, and *ak* to *gk*, that is *ae*, haue all one and the same proportion; and therefore it shall here be needlesse any further to insist hereupon.

Chap. VIII.

How to describe the Rumbes mechanically in any Sea-chart, Globe, or Mappe of what forme soeuer.

NOw becausse the nauticall planisphære (as before hath been shewed) is nothing else but a plaine parallelogramme superficies, made by extension of a sphæricall superficies inscribed into a concaue cylinder, wherein the rumbes make equall angles with euery meridian: therefore in this nauticall planisphære, if a circle be drawne

drawne and diuided into 32 equall parts, beginning at the meridian passing by the centre, of that circle: right lines drawne from the centre by those diuisions shall be the rumbes or lines which the ship describeth in sailing vpon those points, because they make equall angles with euery meridian of the nautical planisphęre, those meridiãs being euery where equidistant one from another. Example hereof you haue in the former figure, and in the charts adioyned hereunto.

By helpe of this planisphęre with the meridians, rumbes, and parallels thus described therein, the rumbes may much more easily and truly be drawne in the globe, then by those mechanical waies which *Petrus Nonius* teacheth, *cap. 26. lib. 2. de obser. Reg. & Instr. Geom.* Hereby also they may with no lesse facilitie be inscribed into any other Chart or mappe of what forme or proiection soeuer, if it be first diuided by meridians and parallels into degrees of longitude and latitude: For by what points of longitude and latitude in this planisphære the rumbes are described, by the same points must they be drawne in the globe, or in any other Chart or mappe whatsoeuer. Notwithstanding this may much more exactly be performed by the table of Rumbes following, which I haue made for that purpose, shewing for euerie degree of longitude, by what degree, minute and second of latitude euerie rumbe is to bee drawne till you come within a minute of the pole.

Chap. IX.

The vſe of the table of Latitudes for making the table of Rumbs.

THis table of Rumbes is moſt eaſily made by addition only with help of the former table of Latitudes, after this manner: Multiplie the *Tangent* of the angle that ỹ rumbe maketh with the æquinoctiall by 60 (becauſe euery degree of the æquinoctiall in that table is vnderſtood to containe 60 times 10000 parts, each min. conteining (by ſuppoſition) 10000 parts:) the product ſhall be the firſt number at the beginning of the table of each rumbe, to be ſet ouer againſt one degree of longitude, and all the reſt are found by perpetuall addition of this number, firſt to it ſelfe (for the ſumme is the number anſwerable to two degrees of longitude) then to this ſumme; (the product is the number that anſwereth to three degrees of longitude) and ſo forth in all the reſt. Theſe numbers being found out in the table of Latitudes, did ſhew at what point of latitude each rumb ſhould croſſe the meridian for euery degree of longitude, till you come within a minute of the pole. But theſe numbers were not thought needfull to be ſet down in the table following, becauſe they ſerue onely for finding out the latitudes, by which the rumbes muſt be drawne at euery degree of longitude; which latitudes being once found, theſe numbers ſerue to no further vſe.

Take

Take for example the first rumbe from the æquinoctiall, making an angle therewith of 11 degrees 15 min. the tangent whereof 1,989,122 (the whole sine being 10000000) multiplied by 60, maketh 119,347,320: but cutting off the three first figures, and seeking out the rest in the table of Latitudes, you shall finde answerable thereto 12 min. the latitude of that rumbe at one degree of longitude. Also the same number doubled (that is 238,694) and found out in the same table, shall giue you 24 min. almost, the latitude of the same rumbe for two degrees of longitude: and so forth in the rest.

To finde presently the latitude of any rumbe for any longitude.

Hereby it may appeare that the latitude of any rumbe, whatsoeuer angle it make with the æquinoctiall, may presently be found for any longitude you shall desire, if you doe but multiplie the number answering to one degree of longitude (found as before) by the longitude giuen, and finde out the product in the second columne of the foresaid table of Latitudes: for the number of degrees, minutes, &c. answering thereto in the first columne of that table shall be the latitude desired.

As for example, suppose a rumbe that maketh an angle of 5 degrees with the æquinoctial, I would know what latitude this rumbe must haue at 360 degrees of longitude: the tangent of fiue degrees is 874,887, which multiplied by 60, make 52,493,220, and this againe by 360 maketh 18,897,559,200; but cutting off the three first figures, the rest found in the foresaid table shall giue vs 30 degrees, 1 minute, the latitude of that rumbe at 360 degrees of longitude.

The first Rumbe from the meridian. } *North and by East, North and by West.* / *South and by East, South and by West.*

Lon.	Latitude.		Lon	Latitude.		Lon.	Latitude.			Lon.	Latitude.		
Deg.	Deg.	Mi	Deg.	Deg.	Mi.	Deg.	Deg.	mi.	Sec	Deg	Deg	mi.	Sec.
1	5	1	31	82	27	61	89	27	2	91	89	57	10
2	10	0	32	83	5	62	89	29	46	92	89	57	22
3	14	55	33	83	40	63	89	32	15	93	89	57	33
4	19	43	34	84	12	64	89	34	33	94	89	57	43
5	24	22	35	84	40	65	89	36	39	95	89	57	53
6	28	52	36	85	8	66	89	38	33	96	89	58	2
7	33	10	37	85	32	67	89	40	19	97	89	58	9
8	37	16	38	85	55	68	89	41	56	98	89	58	15
9	41	10	39	86	15	69	89	43	24	99	89	58	21
10	44	50	40	86	34	70	89	44	45	100	89	58	27
11	48	18	41	86	51	71	89	46	0	101	89	58	33
12	51	32	42	87	8	72	89	47	8	102	89	58	38
13	54	33	43	87	22	73	89	48	10	103	89	58	43
14	57	22	44	87	35	74	89	49	7	104	89	58	47
15	59	58	45	87	47	75	89	49	57	105	89	58	51
16	62	24	46	87	58	76	89	50	47	106	89	58	55
17	64	38	47	88	9	77	89	51	31	107	89	58	59
18	66	42	48	88	18	78	89	52	11	108	89	59	3
19	68	37	49	88	26	79	89	52	38	109	89	59	6
20	70	22	50	88	34	80	89	53	5	110	89	59	9
21	72	0	51	88	41	81	89	53	43	111	89	59	12
22	73	29	52	88	48	82	89	54	20	112	89	59	15
23	74	51	53	88	54	83	89	54	46	113	89	59	18
24	76	7	54	88	59	84	89	55	11	114	89	59	20
25	77	16	55	89	5	85	89	55	30	115	89	59	22
26	78	20	56	89	9	86	89	55	53	116	89	59	24
27	79	18	57	89	13	87	89	56	11	117	89	59	26
28	80	12	58	89	17	88	89	56	28	118	89	59	28
29	81	1	59	89	21	89	89	56	44	119	89	59	30
30	81	46	60	89	24	90	89	56	58	120	89	59	32

The second Rumbe from the Meridian. } *North Northeast, North Northwest: South Southeast, South Southwest.*

Lon.	Latitude.		Lon.	Latitude.		Lon.	Latitude.		Lon.	Latitude.	
Deg.	Deg.	min.	Deg.	Deg.	min.	Deg.	Deg.	min	Deg.	Deg.	min.
1	2	25	31	59	41	61	81	15	92	87	37
2	4	49	32	60	53	62	81	36	94	87	49
3	7	14	33	62	2	63	81	57	96	87	59
4	9	37	34	63	9	64	82	17	98	88	9
5	11	59	35	64	13	65	82	36	100	88	18
6	14	20	36	65	15	66	82	54	102	88	26
7	16	40	37	66	14	67	83	12	104	88	34
8	18	58	38	67	12	68	83	28	106	88	41
9	21	14	39	68	7	69	83	44	108	88	47
10	23	27	40	69	0	70	84	0	110	88	53
11	25	39	41	69	50	71	84	15	112	88	58
12	27	49	42	70	39	72	84	29	114	89	3
13	29	55	43	71	26	73	84	42	116	89	8
14	32	0	44	72	12	74	84	56	118	89	12
15	34	1	45	72	55	75	85	8	120	89	16
16	36	0	46	73	37	76	85	20	122	89	19
17	37	55	47	74	17	77	85	32	124	89	23
18	39	48	48	74	55	78	85	43	126	89	26
19	41	38	49	75	32	79	85	53	128	89	28
20	43	25	50	76	8	80	86	3	130	89	31
21	45	8	51	76	42	81	86	13	134	89	35
22	46	49	52	77	14	82	86	22	138	89	39
23	48	27	53	77	46	83	86	31	142	89	42
24	50	1	54	78	16	84	86	40	146	89	45
25	51	33	55	78	44	85	86	48	150	89	47
26	53	1	56	79	12	86	86	57	158	89	51
27	54	27	57	79	39	87	87	4	166	89	53
28	55	50	58	80	4	88	87	11	178	89	56
29	57	10	59	80	29	89	87	18	201	89	58
30	58	27	60	80	52	90	87	25	225	89	59

The third Rumbe from the meridian.	Northeast by North, Northwest by North. Southeast by South, Southwest by South.

Lon.	Latitude.		Lon.	Latitude.		Lon.	Latitude.		Lon.	Latitude.	
Deg.	Deg.	Mi.	Deg.	Deg.	Mi.	Deg.	Deg.	Mi.	Deg.	Deg.	Mi.
1	1	30	31	42	1	61	67	1	91	79	23
2	3	0	32	43	8	62	67	36	92	79	40
3	4	29	33	44	12	63	68	10	93	79	55
4	5	59	34	45	16	64	68	43	94	80	11
5	7	28	35	46	19	65	69	15	95	80	26
6	8	57	36	47	20	66	69	46	96	80	41
7	10	25	37	48	21	67	70	17	97	80	55
8	11	53	38	49	20	68	70	47	98	81	9
9	13	21	39	50	18	69	71	16	99	81	23
10	14	48	40	51	14	70	71	44	100	81	36
11	16	14	41	52	10	71	72	12	101	81	49
12	17	40	42	53	5	72	72	39	102	82	2
13	19	6	43	53	58	73	73	6	103	82	14
14	20	30	44	54	50	74	73	32	104	82	26
15	21	54	45	55	41	75	73	57	105	82	37
16	23	17	46	56	31	76	74	21	106	82	49
17	24	39	47	57	20	77	74	45	107	83	0
18	26	0	48	58	8	78	75	8	108	83	11
19	27	20	49	58	55	79	75	31	109	83	21
20	28	39	50	59	41	80	75	53	110	83	31
21	29	58	51	60	26	81	76	15	111	83	41
22	31	15	52	61	10	82	76	36	112	83	51
23	32	31	53	61	52	83	76	56	113	84	1
24	33	46	54	62	34	84	77	16	114	84	10
25	35	0	55	63	15	85	77	36	115	84	19
26	36	13	56	63	55	86	77	55	116	84	28
27	37	25	57	64	34	87	78	14	117	84	36
28	38	36	58	65	12	88	78	32	118	84	44
29	39	46	59	65	49	89	78	49	119	84	53
30	40	54	60	66	26	90	79	6	120	85	1

The third rumbe from the meridian. } Northeast & by North, Northwest by North. / Southeast & by South, Southwest & by South.

Lon.	Latitude.	Lon.	Latitude.	Lon.	Latitude.	Lon.	Latitude.
Deg.	Deg. Mi.	Deg.	Deg. Mi.	Deg.	Deg. Mi.	Deg.	Deg. Mi.
121	85 8	151	87 47	181	88 59	212	89 33
122	85 16	152	87 50	182	89 0	214	89 34
123	85 23	153	87 54	183	89 2	216	89 35
124	85 30	154	87 57	184	89 3	218	89 36
125	85 37	155	88 0	185	89 5	220	89 38
126	85 43	156	88 3	186	89 6	222	89 39
127	85 50	157	88 6	187	89 8	224	89 40
128	85 57	158	88 9	188	89 9	226	89 41
129	86 3	159	88 12	189	89 10	228	89 42
130	86 9	160	88 15	190	89 12	230	89 43
131	86 15	161	88 17	191	89 13	234	89 44
132	86 21	162	88 20	192	89 14	238	89 46
133	86 27	163	88 22	193	89 15	242	89 47
134	86 32	164	88 25	194	89 16	246	89 48
135	86 37	165	88 27	195	89 17	250	89 49
136	86 43	166	88 30	196	89 19	254	89 50
137	86 48	167	88 32	197	89 20	258	89 51
138	86 52	168	88 34	198	89 21	262	89 52
139	86 58	169	88 37	199	89 22	266	89 53
140	87 3	170	88 39	200	89 23	270	89 54
141	87 7	171	88 41	201	89 24	276	89 54
142	87 12	172	88 43	202	89 24	282	89 55
143	87 16	173	88 45	203	89 25	288	89 56
144	87 20	174	88 47	204	89 26	294	89 56
145	87 24	175	88 49	205	89 27	300	89 57
146	87 28	176	88 50	206	89 28	312	89 58
147	87 32	177	88 52	207	89 29	324	89 58
148	87 36	178	88 54	208	89 30	336	89 58
149	87 40	179	88 56	209	89 30	348	89 59
150	87 43	180	88 57	210	89 31	360	89 59

The fourth rumbe from the meridian. } *Northeast, Northwest.* / *Southeast, Southwest.*

Lon.	Latitude		Lon.	Latitude.		Lon.	Latitude.		Lon.	Latitude.	
Deg.	Deg.	Mi.	Deg.	Deg.	Mi.	Deg.	Deg.	Mi.	Deg.	Deg.	Mi.
1	1	0	31	29	35	61	51	57	91	66	54
2	2	0	32	30	28	62	52	33	92	67	18
3	3	0	33	31	19	63	53	10	93	67	41
4	4	0	34	32	10	64	53	45	94	68	3
5	5	0	35	33	0	65	54	21	95	68	25
6	5	59	36	33	50	66	54	55	96	68	47
7	6	59	37	34	40	67	55	30	97	69	9
8	7	58	38	35	29	68	56	3	98	69	30
9	8	58	39	36	18	69	56	37	99	69	51
10	9	57	40	37	6	70	57	9	100	70	11
11	10	56	41	37	53	71	57	42	101	70	31
12	11	55	42	38	41	72	58	13	102	70	51
13	12	53	43	39	27	73	58	45	103	71	11
14	13	52	44	40	13	74	59	16	104	71	30
15	14	50	45	40	59	75	59	46	105	71	49
16	15	48	46	41	44	76	60	16	106	72	7
17	16	45	47	42	28	77	60	46	107	72	26
18	17	43	48	43	12	78	61	15	108	72	44
19	18	40	49	43	56	79	61	43	109	73	1
20	19	36	50	44	39	80	62	12	110	73	19
21	20	33	51	45	21	81	62	39	111	73	36
22	21	29	52	46	3	82	63	7	112	73	53
23	22	24	53	46	44	83	63	34	113	74	9
24	23	20	54	47	25	84	64	0	114	74	25
25	24	15	55	48	6	85	64	26	115	74	41
26	25	9	56	48	45	86	64	52	116	74	57
27	26	3	57	49	25	87	65	17	117	75	12
28	26	57	58	50	3	88	65	42	118	75	28
29	27	51	59	50	42	89	66	6	119	75	43
30	28	43	60	51	19	90	66	31	120	75	57

The fourth rumbe from the meridian { Northeast, Northwest. Southeast, Southwest.

Lon.	Latitude		Lon.	Latitude.		Lon.	Latitude		Lon.	Latitude.	
Deg	Deg.	Mi.	Deg.	Deg.	Mi.	Deg.	Deg.	Mi.	Deg.	Deg.	Mi.
121	76	12	151	81	48	181	85	8	211	87	7
122	76	26	152	81	56	182	85	13	212	87	10
123	76	40	153	82	4	183	85	18	213	87	13
124	76	54	154	82	13	184	85	23	214	87	16
125	77	7	155	82	21	185	85	27	215	87	19
126	77	20	156	82	29	186	85	32	216	87	22
127	77	33	157	82	36	187	85	37	217	87	24
128	77	46	158	82	44	188	85	41	218	87	27
129	77	59	159	82	51	189	85	46	219	87	30
130	78	11	160	82	59	190	85	50	220	87	32
131	78	23	161	83	6	191	85	54	221	87	35
132	78	35	162	83	13	192	85	59	222	87	37
133	78	47	163	83	20	193	86	3	223	87	40
134	78	59	164	83	27	194	86	7	224	87	42
135	79	10	165	83	34	195	86	11	225	87	44
136	79	21	166	83	41	196	86	15	226	87	47
137	79	32	167	83	47	197	86	19	227	87	49
138	79	43	168	83	54	198	86	23	228	87	51
139	79	53	169	84	0	199	86	26	229	87	54
140	80	4	170	84	6	200	86	30	230	87	56
141	80	14	171	84	12	201	86	34	231	87	58
142	80	24	172	84	18	202	86	37	232	88	0
143	80	34	173	84	24	203	86	41	233	88	2
144	80	44	174	84	30	204	86	44	234	88	4
145	80	53	175	84	36	205	86	48	235	88	6
146	81	3	176	84	41	206	86	51	236	88	8
147	81	12	177	84	47	207	86	55	237	88	10
148	81	21	178	84	52	208	86	58	238	88	12
149	81	30	179	84	57	209	87	1	239	88	14
150	81	39	180	85	3	210	87	4	240	88	16

The fourth rumbe from the meridian. } Northeast, Northwest. Southeast, Southwest.

Lon.	Latitude.	Lon.	Latitude.	Lon.	Latitude.	Lon.	Latitude.
Deg	Deg. Mi.	Deg.	Deg. Mi.	Deg.	Deg. Mi.	Deg.	Deg. Mi.
241	88 17	271	88 59	302	89 24	6	89 48
242	88 19	272	89 0	304	89 25	12	89 49
243	88 21	273	89 1	306	89 27	18	89 50
244	88 23	274	89 2	308	89 28	24	89 51
245	88 24	275	89 3	310	89 29	30	89 52
246	88 26	276	89 4	312	89 30	36	89 53
247	88 28	277	89 5	314	89 31	42	89 53
248	88 29	278	89 6	316	89 32	48	89 54
249	88 31	279	89 7	318	89 33	54	89 55
250	88 32	280	89 8	320	89 34	60	89 55
251	88 34	281	89 9	322	89 35	66	89 55
252	88 35	282	89 10	324	89 36	72	89 56
253	88 37	283	89 10	326	89 36	78	89 56
254	88 38	284	89 11	328	89 37	84	89 57
255	88 39	285	89 12	330	89 38	90	89 57
256	88 41	286	89 13	332	89 39	96	89 57
257	88 42	287	89 14	334	89 39	102	89 57
258	88 44	288	89 15	336	89 40	108	89 58
259	88 45	289	89 15	338	89 41	114	89 58
260	88 46	290	89 16	340	89 41	120	89 58
261	88 47	291	89 17	342	89 42	126	89 58
262	88 49	292	89 18	344	89 43	132	89 58
263	88 50	293	89 18	346	89 43	138	89 58
264	88 51	294	89 19	348	89 44	144	89 58
265	88 52	295	89 20	350	89 44	150	89 59
266	88 53	296	89 20	352	89 45	156	89 59
267	88 55	297	89 21	354	89 45	162	89 59
268	88 56	298	89 22	356	89 46	168	89 59
269	88 57	299	89 22	358	89 46	174	89 59
270	88 58	300	89 23	360	89 47	180	89 59

The fifth Rumbe from the meridian. } *Northeast & by East, Southeast and by East: Northwest & by West, Southwest and by West.*

Lon.	Latitude.		Lon.	Latitude.		Lon.	Latitude.		Lon.	Latitude.	
Deg.	Deg.	Mi.	Deg.	Deg.	Mi.	Deg.	Deg.	Mi.	Deg.	Deg.	Mi.
1	0	40	31	20	17	61	37	42	91	51	49
2	1	20	32	20	54	62	38	14	92	52	14
3	2	0	33	21	31	63	38	45	93	52	39
4	2	40	34	22	9	64	39	16	94	53	3
5	3	20	35	22	46	65	39	47	95	53	27
6	4	0	36	23	23	66	40	18	96	53	50
7	4	40	37	23	59	67	40	48	97	54	14
8	5	20	38	24	36	68	41	18	98	54	37
9	6	0	39	25	12	69	41	48	99	55	0
10	6	40	40	25	48	70	42	18	100	55	23
11	7	20	41	26	24	71	42	48	101	55	46
12	8	0	42	27	0	72	43	17	102	56	8
13	8	39	43	27	36	73	43	46	103	56	31
14	9	19	44	28	11	74	44	14	104	56	53
15	9	58	45	28	47	75	44	44	105	57	14
16	10	38	46	29	22	76	45	12	106	57	36
17	11	17	47	29	56	77	45	40	107	57	57
18	11	56	48	30	31	78	46	8	108	58	19
19	12	36	49	31	5	79	46	36	109	58	40
20	13	15	50	31	40	80	47	3	110	59	0
21	13	54	51	32	14	81	47	30	111	59	20
22	14	32	52	32	48	82	47	57	112	59	41
23	15	11	53	33	21	83	48	24	113	60	1
24	15	50	54	33	55	84	48	50	114	60	21
25	16	28	55	34	28	85	49	17	115	60	41
26	17	7	56	35	1	86	49	43	116	61	0
27	17	45	57	35	33	87	50	9	117	61	20
28	18	33	58	36	5	88	50	34	118	61	39
29	19	1	59	36	38	89	50	59	119	61	58
30	19	39	60	37	10	90	51	25	120	62	17

The fifth Rumbe from the meridian. { *Northeast and by East, Southeast and by East: Northwest and by West, Southwest and by West.*

Lon.	Latitude.		Lon.	Latitude.		Lon.	Latitude.		Lon.	Latitude	
Deg.	Deg.	Mi.	Deg.	Deg.	Mi.	Deg	Deg.	Mi.	Deg.	Deg.	Mi.
121	62	35	151	70	29	181	76	11	211	80	14
122	62	53	152	70	43	182	76	20	212	80	21
123	63	12	153	70	56	183	76	30	213	80	27
124	63	30	154	71	9	184	76	39	214	80	34
125	63	47	155	71	22	185	76	48	215	80	41
126	64	6	156	71	35	186	76	57	216	80	47
127	64	22	157	71	47	187	77	6	217	80	53
128	64	40	158	72	0	188	77	15	218	81	0
129	64	57	159	72	12	189	77	24	219	81	6
130	65	14	160	72	24	190	77	33	220	81	12
131	65	30	161	72	36	191	77	41	221	81	18
132	65	47	162	72	48	192	77	50	222	81	24
133	66	3	163	73	0	193	77	58	223	81	30
134	66	19	164	73	11	194	78	6	224	81	36
135	66	35	165	73	23	195	78	15	225	81	42
136	66	51	166	73	34	196	78	23	226	81	48
137	67	7	167	73	46	197	78	31	227	81	53
138	67	22	168	73	57	198	78	39	228	81	59
139	67	38	169	74	8	199	78	47	229	82	4
140	67	53	170	74	19	200	78	54	230	82	10
141	68	8	171	74	29	201	79	2	231	82	15
142	68	23	172	74	40	202	79	10	232	82	21
143	68	37	173	74	51	203	79	17	233	82	26
144	68	52	174	75	1	204	79	24	234	82	31
145	69	6	175	75	11	205	79	32	235	82	36
146	69	21	176	75	22	206	79	39	236	82	42
147	69	35	177	75	32	207	79	46	237	82	47
148	69	49	178	75	42	208	79	53	238	82	52
149	70	2	179	75	51	209	80	0	239	82	57
150	70	16	180	76	1	210	80	7	240	83	2

The fifth rumbe from the meridian. } Northeast and by East, Southeast and by East: Northwest and by West, Southwest and by West.

Lon.	Latitude.		Lon.	Latitude		Lon.	Latitude.		Lon	Latitude.	
Deg.	Deg.	Mi.	Deg	Deg.	Mi	Deg	Deg.	Mi	Deg	Deg.	Mi.
241	83	6	271	85	8	301	86	34	331	87	35
242	83	11	272	85	12	302	86	36	332	87	37
243	83	16	273	85	15	303	86	39	333	87	38
244	83	21	274	85	18	304	86	41	334	87	40
245	83	25	275	85	21	305	86	43	335	87	42
246	83	30	276	85	25	306	86	46	336	87	43
247	83	34	277	85	28	307	86	48	337	87	45
248	83	39	278	85	31	308	86	50	338	87	47
249	83	43	279	85	34	309	86	57	339	87	48
250	83	47	280	85	37	310	86	55	340	87	50
251	83	52	281	85	40	311	86	57	341	87	51
252	84	56	282	85	43	312	86	59	342	87	53
253	84	0	283	85	46	313	87	1	343	87	54
254	84	4	284	85	49	314	87	3	344	87	55
255	84	8	285	85	52	315	87	6	345	87	57
256	84	13	286	85	55	316	87	8	346	87	58
257	84	17	287	85	58	317	87	10	347	88	0
258	84	21	288	86	0	318	87	12	348	88	1
259	84	24	289	86	3	319	87	13	349	88	2
260	84	28	290	86	6	320	87	15	350	88	4
261	84	32	291	86	8	321	87	17	351	88	5
262	84	36	292	86	11	322	87	19	352	88	6
263	84	40	293	86	14	323	87	21	353	88	8
264	84	43	294	86	17	324	87	23	354	88	9
265	84	47	295	86	19	325	87	25	355	88	10
266	84	51	296	86	22	326	87	26	356	88	12
267	84	54	297	86	24	327	87	28	357	88	13
268	84	58	298	86	27	328	87	30	358	88	14
269	85	1	299	86	29	329	87	32	359	88	15
270	85	5	300	86	32	330	87	33	360	88	17

The fifth rumbe from the meridian. { Northeast and by East, Southeast and by East: Northwest and by West, Southwest and by West.

Lon.	Latitude.		Lon.	Latitude.		Lon.	Latitude.		Lon.	Latitude.	
Deg	Deg.	Mi.	Deg	Deg.	Mi.	Deg	Deg.	Mi.	Deg	Deg.	Mi.
1	88	18	32	88	49	92	89	24	155	89	43
2	88	19	34	88	50	94	89	25	160	89	44
3	88	20	36	88	52	96	89	26	165	89	44
4	88	21	38	88	53	98	89	27	170	89	45
5	88	22	40	88	55	100	89	27	175	89	46
6	88	23	42	88	56	102	89	28	180	89	47
7	88	25	44	88	58	104	89	29	185	89	48
8	88	26	46	88	59	106	89	30	190	89	48
9	88	27	48	89	1	108	89	30	195	89	49
10	88	28	50	89	2	110	89	31	200	89	49
11	88	29	52	89	3	112	89	32	210	89	51
12	88	30	54	89	5	114	89	32	220	89	52
13	88	31	56	89	6	116	89	33	230	89	52
14	88	32	58	89	7	118	89	33	240	89	53
15	88	33	60	89	8	120	89	34	250	89	54
16	88	34	62	89	10	122	89	35	260	89	55
17	88	35	64	89	11	124	89	35	270	89	55
18	88	36	66	89	12	126	89	36	280	89	56
19	88	37	68	89	13	128	89	36	290	89	56
20	88	38	70	89	14	130	89	37	300	89	56
21	88	39	72	89	15	132	89	37	310	89	57
22	88	40	74	89	16	134	89	38	320	89	57
23	88	41	76	89	17	136	89	38	330	89	57
24	88	42	78	89	18	138	89	39	340	89	58
25	88	43	80	89	19	140	89	39	350	89	58
26	88	43	82	89	20	142	89	40	360	89	58
27	88	44	84	89	21	144	89	40	30	89	58
28	88	45	86	89	22	146	89	41	60	89	59
29	88	46	88	89	23	148	89	41	90	89	59
30	88	47	90	89	23	150	89	42	120	89	59

The sixth rumbe from the meridian. } East Northeast, East Southeast: West Northwest, West Southwest.

Lon.	Latitude.		Lon.	Latitude.		Lon.	Latitude.		Lon.	Latitude.	
Deg	Deg.	Mi.	Deg	Deg.	Mi.	Deg	Deg.	Mi.	Deg.	Deg.	Mi.
1	0	25	31	12	44	61	24	29	91	35	14
2	0	50	32	13	8	62	24	52	92	35	34
3	1	15	33	13	32	63	25	14	93	35	55
4	1	39	34	13	57	64	25	37	94	36	15
5	2	4	35	14	21	65	25	59	95	36	35
6	2	29	36	14	45	66	26	21	96	36	55
7	2	54	37	15	9	67	26	44	97	37	14
8	3	19	38	15	33	68	27	6	98	37	34
9	3	44	39	15	57	69	27	28	99	37	54
10	4	8	40	16	21	70	27	50	100	38	13
11	4	33	41	16	44	71	28	12	101	38	32
12	4	58	42	17	8	72	28	34	102	38	52
13	5	23	43	17	31	73	28	55	103	39	12
14	5	47	44	17	55	74	29	17	104	39	31
15	6	12	45	18	20	75	29	39	105	39	49
16	6	37	46	18	42	76	30	0	106	40	8
17	7	1	47	19	6	77	30	22	107	40	27
18	7	26	48	19	29	78	30	43	108	40	47
19	7	51	49	19	53	79	31	5	109	41	6
20	8	15	50	20	16	80	31	26	110	41	24
21	8	40	51	20	40	81	31	46	111	41	42
22	9	4	52	21	2	82	32	8	112	42	1
23	9	29	53	21	26	83	32	29	113	42	20
24	9	54	54	21	49	84	32	50	114	42	38
25	10	17	55	22	12	85	33	10	115	42	56
26	10	42	56	22	35	86	33	32	116	43	14
27	11	7	57	22	58	87	33	52	117	43	32
28	11	31	58	23	20	88	34	12	118	43	50
29	11	56	59	23	44	89	34	33	119	44	8
30	12	20	60	24	6	90	34	54	120	44	26

The sixth rumbe from the meridian. } *East Northeast, East Southeast: West Northwest, West Southwest.*

Lon.	Latitude.		Lon.	Latitude		Lon.	Latitude.		Lon.	Latitude.	
Deg.	Deg.	min.	Deg.	Deg.	min.	Deg.	Deg.	min.	Deg.	Deg.	min.
121	44	43	151	52	53	181	59	45	211	65	27
122	45	1	152	53	8	182	59	58	212	65	37
123	45	18	153	53	23	183	60	10	213	65	48
124	45	36	154	53	37	184	60	22	214	65	58
125	45	53	155	53	53	185	60	35	215	66	8
126	46	10	156	54	7	186	60	47	216	66	18
127	46	28	157	54	21	187	60	59	217	66	28
128	46	45	158	54	36	188	61	11	218	66	38
129	47	2	159	54	50	189	61	23	219	66	48
130	47	19	160	55	4	190	61	35	220	66	57
131	47	35	161	55	18	191	61	47	221	67	7
132	47	53	162	55	33	192	61	58	222	67	17
133	48	9	163	55	47	193	62	10	223	67	26
134	48	25	164	56	0	194	62	21	224	67	36
135	48	42	165	56	14	195	62	33	225	67	45
136	48	59	166	56	28	196	62	44	226	67	54
137	49	14	167	56	42	197	62	56	227	68	4
138	49	31	168	56	55	198	63	7	228	68	13
139	49	47	169	57	9	199	63	18	229	68	22
140	50	3	170	57	22	200	63	29	230	68	31
141	50	18	171	57	36	201	63	40	231	68	40
142	50	34	172	57	50	202	63	51	232	68	49
143	50	51	173	58	2	203	64	2	233	68	58
144	51	6	174	58	15	204	64	13	234	69	7
145	51	21	175	58	28	205	64	24	235	69	16
146	51	37	176	58	41	206	64	36	236	69	25
147	51	53	177	58	54	207	64	45	237	69	34
148	52	7	178	59	7	208	64	56	238	69	42
149	52	23	179	59	20	209	65	6	239	69	51
150	52	38	180	59	32	210	65	17	240	69	59

The sixth rumbe from the meridian. } *East Northeast, East Southeast.* / *West Northwest, West Southwest.*

Lon.	Latitude.		Lon.	Latitude.		Lon.	Latitude.		Lon.	Latitude.	
Deg	Deg.	Mi.	Deg.	Deg.	Mi.	Deg	Deg.	Mi.	Deg	Deg.	Mi.
241	70	8	271	73	57	301	77	3	331	79	33
242	70	16	272	74	4	302	77	8	332	79	38
243	70	25	273	74	10	303	77	14	333	79	42
244	70	33	274	74	17	304	77	19	334	79	47
245	70	41	275	74	24	305	77	25	335	79	51
246	70	49	276	74	31	306	77	30	336	79	55
247	70	57	277	74	37	307	77	35	337	80	0
248	71	6	278	74	44	308	77	41	338	80	4
249	71	14	279	74	50	309	77	46	339	80	8
250	71	22	280	74	57	310	77	51	340	80	12
251	71	29	281	75	3	311	77	56	341	80	17
252	71	37	282	75	9	312	78	2	342	80	21
253	71	45	283	75	16	313	78	7	343	80	25
254	71	53	284	75	22	314	78	12	344	80	29
255	72	1	285	75	28	315	78	17	345	80	33
256	72	8	286	75	35	316	78	22	346	80	37
257	72	16	287	75	41	317	78	27	347	80	41
258	72	23	288	75	47	318	78	32	348	80	45
259	72	31	289	75	53	319	78	37	349	80	49
260	72	38	290	75	59	320	78	42	350	80	53
261	72	46	291	76	5	321	78	47	351	80	57
262	72	53	292	76	11	322	78	51	352	81	1
263	73	0	293	76	17	323	78	56	353	81	5
264	73	7	294	76	22	324	79	1	354	81	9
265	73	15	295	76	29	325	79	6	355	81	13
266	73	22	296	76	34	326	79	10	356	81	16
267	73	29	297	76	40	327	79	15	357	81	20
268	73	36	298	76	46	328	79	20	358	81	24
269	73	43	299	76	51	329	79	24	359	81	28
270	73	50	300	76	57	330	79	29	360	81	31

The sixth rumbe from the meridian. } East Northeast, East Southeast: West Northwest, West Southwest.

Lon.	Latitude.		Lon.	Latitude.		Lon.	Latitude.		Lon.	Latitude.	
Deg	Deg	Mi.	Deg	Deg.	Mi.	Deg	Deg.	Mi.	Deg	Deg.	Mi.
1	81	35	31	83	13	61	84	32	91	85	36
2	81	38	32	83	16	62	84	34	92	85	38
3	81	42	33	83	19	63	84	37	93	85	40
4	81	46	34	83	22	64	84	39	94	85	42
5	81	49	35	83	25	65	84	41	95	85	43
6	81	53	36	83	27	66	84	44	96	85	45
7	81	56	37	83	30	67	84	46	97	85	47
8	82	0	38	83	33	68	84	48	98	85	49
9	82	3	39	83	36	69	84	50	99	85	51
10	82	7	40	83	39	70	84	53	100	85	52
11	82	9	41	83	41	71	84	55	101	85	54
12	82	13	42	83	44	72	84	57	102	85	56
13	82	17	43	83	47	73	84	59	103	85	57
14	82	20	44	83	49	74	85	1	104	85	59
15	82	23	45	83	52	75	85	4	105	86	1
16	82	27	46	83	55	76	85	6	106	86	3
17	82	30	47	83	57	77	85	8	107	86	5
18	82	33	48	84	0	78	85	10	108	86	6
19	82	36	49	84	2	79	85	12	109	86	8
20	82	39	50	84	5	80	85	14	110	86	10
21	82	43	51	84	8	81	85	16	111	86	11
22	82	46	52	84	10	82	85	18	112	86	13
23	82	49	53	84	13	83	85	20	113	86	15
24	82	52	54	84	15	84	85	22	114	86	16
25	82	55	55	84	18	85	85	24	115	86	17
26	82	58	56	84	20	86	85	26	116	86	19
27	83	1	57	84	22	87	85	28	117	86	21
28	83	4	58	84	25	88	85	30	118	86	23
29	83	7	59	84	27	89	85	32	119	86	24
30	83	10	60	84	30	90	85	34	120	86	26

The sixth rumbe from the meridian. } *East Northeast, East Southeast.* / *West Northwest; West Southwest.*

Lon.	Latitude.		Lon.	Latitude.		Lon.	Latitude.		Lon.	Latitude.	
Deg.	Deg.	Mi.	Deg.	Deg.	Mi.	Deg.	Deg.	Mi.	Deg.	Deg.	Mi.
122	86	29	182	87	43	244	88	32	8	89	24
124	86	32	184	87	45	248	88	35	16	89	26
126	86	35	186	87	47	252	88	37	24	89	28
128	86	38	188	87	49	256	88	40	32	89	30
130	86	41	190	87	51	260	88	42	40	89	31
132	86	43	192	87	53	264	88	44	48	89	33
134	86	46	194	87	55	268	88	46	56	89	34
136	86	49	196	87	56	272	88	48	64	89	36
138	86	52	198	87	58	276	88	50	72	89	37
140	86	55	200	88	0	280	88	52	80	89	38
142	86	58	202	88	2	284	88	54	88	89	40
144	87	0	204	88	3	288	88	56	96	89	41
146	87	3	206	88	5	292	88	58	104	89	42
148	87	5	208	88	7	296	89	0	112	89	43
150	87	8	210	88	8	300	89	1	120	89	44
152	87	10	212	88	10	304	89	3	136	89	45
154	87	13	214	88	11	308	89	5	152	89	47
156	87	15	216	88	13	312	89	6	168	89	48
158	87	17	218	88	14	316	89	8	184	89	50
160	87	20	220	88	16	320	89	9	200	89	51
162	87	22	222	88	17	324	89	11	216	89	52
164	87	24	224	88	19	328	89	12	240	89	53
166	87	27	226	88	20	332	89	13	264	89	54
168	87	29	228	88	22	336	89	15	288	89	55
170	87	31	230	88	23	340	89	16	312	89	56
172	87	33	232	88	25	344	89	17	336	89	56
174	87	35	234	88	26	348	89	18	360	89	57
176	87	37	236	88	27	352	89	20	90	89	58
178	87	39	238	88	29	356	89	21	180	89	59
180	87	41	240	88	30	360	89	22	270	89	59

The seuenth rumbe from the meridian. { East and by North, East and by South. / West and by North, West and by South.

Lon.	Latitude.	Lon.	Latitude.	Lon.	Latitude.	Lon.	Latitude.
Deg	Deg. Mi.	Deg	Deg. Mi.	Deg	Deg. Mi.	Deg	Deg. Mi.
1	0 12	31	6 9	61	12 3	91	17 48
2	0 24	32	6 21	62	12 14	92	18 0
3	0 36	33	6 33	63	12 25	93	18 11
4	0 48	34	6 45	64	12 38	94	18 22
5	1 0	35	6 57	65	12 49	95	18 34
6	1 12	36	7 9	66	13 1	96	18 44
7	1 24	37	7 20	67	13 13	97	18 56
8	1 35	38	7 32	68	13 24	98	19 8
9	1 47	39	7 44	69	13 36	99	19 20
10	1 59	40	7 56	70	13 47	100	19 30
11	2 11	41	8 8	71	13 59	101	19 41
12	2 23	42	8 19	72	14 11	102	19 53
13	2 35	43	8 32	73	14 22	103	20 4
14	2 47	44	8 43	74	14 34	104	20 15
15	2 59	45	8 54	75	14 45	105	20 26
16	3 11	46	9 7	76	14 57	106	20 37
17	3 23	47	9 18	77	15 8	107	20 49
18	3 35	48	9 30	78	15 20	108	21 0
19	3 47	49	9 42	79	15 31	109	21 11
20	3 59	50	9 53	80	15 43	110	21 22
21	4 10	51	10 6	81	15 54	111	21 33
22	4 22	52	10 17	82	16 6	112	21 44
23	4 34	53	10 29	83	16 17	113	21 55
24	4 46	54	10 40	84	16 29	114	22 6
25	4 58	55	10 53	85	16 40	115	22 17
26	5 10	56	11 4	86	16 51	116	22 28
27	5 22	57	11 16	87	17 3	117	22 39
28	5 34	58	11 28	88	17 14	118	22 50
29	5 45	59	11 39	89	17 26	119	23 1
30	5 57	60	11 51	90	17 37	120	23 12

The seuenth rumbe from the meridian. } East and by North, East and by South: West and by North, West and by South.

Lon	Latitude.		Lon.	Latitude		Lon.	Latitude.		Lon.	Latitude.	
Deg	Deg.	min.	Deg.	Deg.	min.	Deg.	Deg.	min	Deg.	Deg.	min.
121	23	23	151	28	45	181	33	51	211	38	39
122	23	34	152	28	55	182	34	1	212	38	48
123	23	45	153	29	6	183	34	10	213	38	58
124	23	56	154	29	16	184	34	20	214	39	7
125	24	7	155	29	27	185	34	30	215	39	16
126	24	18	156	29	37	186	34	40	216	39	25
127	24	29	157	29	47	187	34	50	217	39	35
128	24	40	158	29	58	188	35	0	218	39	44
129	24	51	159	30	8	189	35	9	219	39	53
130	25	1	160	30	18	190	35	19	220	40	2
131	25	12	161	30	29	191	35	29	221	40	11
132	25	23	162	30	39	192	35	38	222	40	20
133	25	34	163	30	49	193	35	48	223	40	30
134	25	45	164	30	59	194	35	58	224	40	39
135	25	55	165	31	10	195	36	7	225	40	48
136	26	6	166	31	20	196	36	17	226	40	57
137	26	17	167	31	30	197	36	26	227	41	6
138	26	27	168	31	40	198	36	36	228	41	15
139	26	38	169	31	50	199	36	46	229	41	24
140	26	49	170	32	0	200	36	55	230	41	33
141	26	59	171	32	11	201	37	5	231	41	41
142	27	10	172	32	20	202	37	14	232	41	50
143	27	21	173	32	31	203	37	24	233	41	59
144	27	31	174	32	41	204	37	33	234	42	8
145	27	42	175	32	51	205	37	43	235	42	17
146	27	52	176	33	1	206	37	52	236	42	26
147	28	3	177	33	11	207	38	2	237	42	35
148	28	13	178	33	21	208	38	11	238	42	43
149	28	24	179	33	31	209	38	20	239	42	52
150	28	34	180	33	41	210	38	30	240	43	1

The seuenth rumbe from the meridian. } East and by North, East and by South: West and by North, West and by South.

Lon.	Latitude.		Lon.	Latitude.		Lon.	Latitude.		Lon.	Latitude.	
Deg.	Deg.	min.	Deg.	Deg.	min.	Deg.	Deg.	min.	Deg.	Deg.	min.
241	43	10	271	47	21	301	51	15	331	54	50
242	43	18	272	47	29	302	51	22	332	54	57
243	43	27	273	47	38	303	51	30	333	55	3
244	43	36	274	47	46	304	51	37	334	55	10
245	43	44	275	47	54	305	51	44	335	55	17
246	43	53	276	48	2	306	51	52	336	55	24
247	44	1	277	48	10	307	51	59	337	55	31
248	44	10	278	48	17	308	52	6	338	55	37
249	44	19	279	48	25	209	52	14	339	55	44
250	44	27	280	48	33	310	52	21	340	55	51
251	44	36	281	48	41	311	52	28	341	55	58
252	44	44	282	48	49	312	52	36	342	56	4
253	44	53	283	48	57	313	52	43	343	56	11
254	45	1	284	49	5	314	52	50	344	56	17
255	45	9	285	49	13	315	52	57	345	56	24
256	45	18	286	49	20	316	53	4	346	56	31
257	45	26	287	49	28	317	53	12	347	56	37
258	45	35	288	49	36	318	53	19	248	56	44
259	45	43	289	49	44	319	53	26	349	56	50
260	45	51	290	49	51	320	53	33	350	56	57
261	46	0	291	49	59	321	53	40	351	57	3
262	46	8	292	50	7	322	53	47	352	57	10
263	46	16	293	50	14	323	53	54	353	57	16
264	46	24	294	50	22	324	54	1	354	57	23
265	46	33	295	50	29	325	54	8	355	57	29
266	46	41	296	50	37	326	54	15	356	57	36
267	46	49	297	50	45	327	54	22	357	57	42
268	46	57	298	50	52	328	54	29	358	57	48
269	47	5	299	51	0	329	54	36	359	57	55
270	47	13	300	51	7	330	54	43	360	58	1

The seuenth rumbe from the meridian. { East and by North, East and by South: West and by North, West and by South.

Lon.	Latitude.		Lon.	Latitude.		Lon.	Latitude.		Lon.	Latitude.	
Deg.	Deg.	Mi.	Deg.	Deg.	Mi.	Deg.	Deg.	Mi.	Deg.	Deg.	Mi.
1	58	7	31	61	8	61	63	53	91	66	24
2	58	14	32	61	14	62	63	58	92	66	28
3	58	20	33	61	20	63	64	4	93	66	33
4	58	26	34	61	25	64	64	9	94	66	38
5	58	32	35	61	31	65	64	14	95	66	43
6	58	39	36	61	37	66	64	19	96	66	47
7	58	45	37	61	42	67	64	24	97	66	52
8	58	51	38	61	48	68	64	30	98	66	57
9	58	57	39	61	54	69	64	35	99	67	1
10	59	3	40	61	59	70	64	40	100	67	6
11	59	9	41	62	5	71	64	45	101	67	11
12	59	16	42	62	10	72	64	50	102	67	15
13	59	22	43	62	16	73	64	55	103	67	20
14	59	28	44	62	22	74	65	0	104	67	24
15	59	34	45	62	27	75	65	5	105	67	29
16	59	40	46	62	33	76	65	10	106	67	34
17	59	46	47	62	38	77	65	15	107	67	38
18	59	52	48	62	44	78	65	20	108	67	43
19	59	58	49	62	49	79	65	25	109	67	47
20	60	4	50	62	54	80	65	30	110	67	52
21	60	10	51	63	0	81	65	35	111	67	56
22	60	16	52	63	5	82	65	40	112	68	1
23	60	22	53	63	11	83	65	45	113	68	5
24	60	27	54	63	16	84	65	50	114	68	10
25	60	33	55	63	21	85	65	55	115	68	14
26	60	39	56	63	27	86	66	0	116	68	18
27	60	45	57	63	32	87	66	4	117	68	23
28	60	51	58	63	37	88	66	9	118	68	27
29	60	57	59	63	43	89	66	14	119	68	32
30	61	2	60	63	48	90	66	19	120	68	36

The seuenth rumbe from the meridian. } *East and by North, East and by South: West and by North, West and by South.*

Lon.	Latitude.		Lon.	Latitude.		Lon.	Latitude.		Lon.	Latitude.	
Deg.	Deg.	Mi.	Deg	Deg.	Mi.	Deg.	Deg.	Mi.	Deg	Deg.	Mi.
121	68	40	151	70	44	181	72	37	211	74	19
122	68	45	152	70	48	182	72	40	212	74	22
123	68	49	153	70	52	183	72	44	213	74	25
124	68	53	154	70	56	184	72	47	214	74	28
125	68	58	155	71	0	185	72	51	215	74	31
126	69	2	156	71	4	186	72	54	216	74	35
127	69	6	157	71	8	187	72	58	217	74	38
128	69	10	158	71	12	188	73	1	218	74	41
129	69	15	159	71	15	189	73	5	219	74	44
130	69	19	560	71	19	190	73	8	220	74	47
131	69	23	161	71	23	191	73	12	221	74	50
132	69	27	162	71	27	192	73	15	222	74	53
133	69	31	163	71	31	193	73	18	223	74	56
134	69	36	164	71	34	194	73	22	224	75	0
135	69	40	165	71	38	195	73	25	225	75	3
136	69	44	166	71	42	196	73	29	226	75	6
137	69	48	167	71	46	197	73	32	227	75	9
138	69	52	168	71	49	198	73	36	228	75	12
139	69	56	169	71	53	199	73	39	229	75	15
140	70	0	170	71	57	200	73	42	230	75	18
141	70	4	171	72	0	201	73	46	231	75	21
142	70	8	172	72	4	202	73	49	232	75	24
143	70	12	173	72	8	203	73	52	233	75	27
144	70	16	174	72	11	204	73	56	234	75	30
145	70	20	175	72	15	205	73	59	235	75	33
146	70	24	176	72	19	206	74	2	236	75	36
147	70	28	177	72	22	207	74	6	237	75	39
148	70	32	178	72	26	208	74	9	238	75	42
149	70	36	179	72	30	209	74	12	239	75	45
150	70	40	180	72	33	210	74	15	240	75	48

The seuenth rumbe from the meridian. { *East and by North, East and by South: West and by North, West and by South.*

Lon.	Latitude		Lon.	Latitude.		Lon.	Latitude.		Lon.	Latitude.	
Deg.	Deg.	Mi.	Deg.	Deg.	Mi.	Deg	Deg.	Mi.	Deg.	Deg.	Mi.
241	75	51	271	77	14	301	78	29	331	79	37
242	75	54	272	77	16	302	78	31	332	79	39
243	75	56	273	77	19	303	78	34	333	79	41
244	75	59	274	77	22	304	78	36	334	79	43
245	76	2	275	77	24	305	78	38	335	79	45
246	76	5	276	77	27	306	78	41	336	79	48
247	76	8	277	77	29	307	78	43	337	79	50
248	76	11	278	77	32	308	78	46	338	79	52
249	76	14	279	77	35	309	78	48	339	79	54
250	76	16	280	77	37	310	78	50	340	79	56
251	76	19	281	77	40	311	78	52	341	79	58
252	76	22	282	77	42	312	78	55	342	80	0
253	76	25	283	77	45	313	78	57	343	80	2
254	76	28	284	77	47	314	78	59	344	80	4
255	76	30	285	77	50	315	79	2	345	80	6
256	76	33	286	77	52	316	79	4	346	80	8
257	76	36	287	77	55	317	79	6	347	80	10
258	76	39	288	77	57	318	79	8	348	80	12
259	76	42	289	78	0	319	79	11	249	80	14
260	76	44	290	78	2	320	79	13	350	80	16
261	76	47	291	78	5	321	79	15	351	80	18
262	76	50	292	78	7	322	79	17	352	80	20
263	76	52	293	78	10	323	79	19	353	80	22
264	76	55	294	78	12	324	79	22	354	80	24
265	76	58	295	78	15	325	79	24	355	80	26
266	77	1	296	78	17	326	79	26	356	80	28
267	77	3	297	78	19	327	79	28	357	80	30
268	77	6	298	78	22	328	79	30	358	80	32
269	77	9	299	78	24	329	79	33	359	80	34
270	77	11	300	78	27	330	79	35	360	80	36

The seuenth rumbe from the meridian. } *East and by North, East and by South: West and by North, West and by South.*

Lon.	Latitude.		Lon.	Latitude.		Lon.	Latitude.		Lon.	Latitude.	
Deg.	Deg.	min.	Deg.	Deg.	min.	Deg.	Deg.	min	Deg.	Deg.	min.
2	80	40	62	82	25	122	83	50	183	85	1
4	80	44	64	82	28	124	83	53	186	85	4
6	80	48	66	82	31	126	83	55	189	85	7
8	80	52	68	82	34	128	83	58	192	85	10
10	80	55	70	82	37	130	84	0	195	85	13
12	80	59	72	82	40	132	84	3	198	85	16
14	81	3	74	82	43	134	84	5	201	85	19
16	81	7	76	82	47	136	84	8	204	85	20
18	81	10	78	82	49	138	84	10	207	85	24
20	81	14	80	82	52	140	84	13	210	85	27
22	81	18	82	82	55	142	84	15	213	85	30
24	81	21	84	82	58	144	84	17	216	85	33
26	81	25	86	83	1	146	84	20	219	85	36
28	81	28	88	83	4	148	84	22	222	85	38
30	81	32	90	83	7	150	84	24	225	85	41
32	81	35	92	83	10	152	84	26	228	85	44
34	81	39	94	83	13	154	84	29	231	85	46
36	81	42	96	83	15	156	84	31	234	85	49
38	81	46	98	83	18	158	84	34	237	85	52
40	81	49	100	83	21	160	84	36	240	85	54
42	81	52	102	83	24	162	84	38	243	85	57
44	81	56	104	83	27	164	84	40	246	85	59
46	81	59	106	83	29	166	84	42	249	86	2
48	82	2	108	83	32	168	84	45	252	86	4
50	82	6	110	83	35	170	84	47	255	86	7
52	82	9	112	83	37	172	84	49	258	86	9
54	82	12	114	83	40	174	84	51	261	86	11
56	82	15	116	83	43	176	84	53	264	86	14
58	82	19	118	83	45	178	84	55	267	86	16
60	82	22	120	83	48	180	84	58	270	86	18

The seuenth rumbe from the meridian. { *East and by North, East and by South: West and by North, West and by South.*

Lon.	Latitude.		Lon.	Latitude.		Lon.	Latitude.		Lon.	Latitude.	
Deg.	Deg.	Mi.	Deg.	Deg.	Mi.	Deg	Deg.	Mi.	Deg.	Deg.	Mi.
273	86	21	3	87	20	126	88	15	12	89	15
276	86	23	6	87	22	132	88	17	24	89	17
279	86	25	9	87	23	138	88	20	36	89	19
282	86	28	12	87	25	144	88	22	48	89	20
285	86	30	15	87	26	150	88	24	60	89	22
288	86	32	18	87	28	156	88	26	72	89	24
291	86	34	21	87	30	162	88	28	84	89	25
294	86	36	24	87	31	168	88	29	98	89	27
297	86	38	27	87	33	174	88	31	114	89	28
300	86	40	30	87	34	180	88	33	130	89	30
303	86	42	33	87	36	189	88	36	146	89	32
306	86	44	36	87	37	198	88	38	162	89	33
309	86	46	39	87	39	207	88	41	178	88	35
312	86	48	42	87	40	216	88	43	194	88	36
315	86	50	45	87	42	225	88	46	210	88	37
318	86	52	48	87	43	234	88	48	240	89	39
321	86	55	51	87	44	243	88	50	270	89	41
324	86	57	54	87	46	252	88	52	300	89	43
327	86	59	57	87	47	261	88	54	330	89	45
330	87	1	60	87	49	270	88	56	360	89	46
333	87	2	66	87	51	279	88	58	36	89	48
336	87	4	72	87	54	288	89	0	72	89	49
339	87	6	78	87	56	297	89	2	108	89	50
342	87	8	84	87	59	306	89	4	144	89	51
345	87	10	90	88	1	315	89	5	180	89	52
348	87	11	96	88	4	324	89	7	240	89	54
351	87	13	102	88	6	333	89	9	360	89	56
354	87	15	108	88	9	342	89	10	180	89	57
357	87	17	114	88	11	351	89	12	360	89	58
360	87	18	120	88	13	360	89	13	180	89	59

The eighth Rumbe from the meridian. } East: West.

Latitude.	1. deg. of lon.	Differ.	Latitude	1. deg. of lon.	Differ.
Deg. Mi.	min. sec. thir.	sec. thir.	Deg. Mi.	min. sec. thir.	sec. thir.
0 10	59 59 59	0 1	5 10	59 45 22	0 56
0 20	59 59 56	0 3	5 20	59 44 25	0 57
0 30	59 59 52	0 4	5 30	59 43 26	0 59
0 40	59 59 45	0 7	5 40	59 42 24	1 2
0 50	59 59 37	0 8	5 50	59 41 21	1 3
1 0	59 59 27	0 10	6 0	59 40 17	1 4
1 10	59 59 15	0 12	6 10	59 39 10	1 7
1 20	59 59 2	0 13	6 20	59 38 2	1 8
1 30	59 58 46	0 16	6 30	59 36 52	1 10
1 40	59 58 29	0 17	6 40	59 35 39	1 13
1 50	59 58 9	0 20	6 50	59 34 26	1 13
2 0	59 57 48	0 21	7 0	59 33 10	1 16
2 10	59 57 26	0 22	7 10	59 31 52	1 18
2 20	59 57 1	0 25	7 20	59 30 33	1 19
2 30	59 56 34	0 27	7 30	59 29 12	1 21
2 40	59 56 6	0 28	7 40	59 27 49	1 23
2 50	59 55 36	0 30	7 50	59 26 24	1 25
3 0	59 55 4	0 32	8 0	59 24 58	1 26
3 10	59 54 30	0 34	8 10	59 23 30	1 28
3 20	59 53 55	0 35	8 20	59 21 59	1 31
3 30	59 53 17	0 38	8 30	59 20 27	1 32
3 40	59 52 38	0 39	8 40	59 18 54	1 33
3 50	59 51 57	0 41	8 50	59 17 18	1 36
4 0	59 51 14	0 43	9 0	59 15 41	1 37
4 10	59 50 29	0 45	9 10	59 14 1	1 40
4 20	59 49 43	0 46	9 20	59 12 20	1 41
4 30	59 48 54	0 49	9 30	59 10 38	1 42
4 40	59 48 4	0 50	9 40	59 8 53	1 45
4 50	59 47 12	0 52	9 50	59 7 7	1 46
5 0	59 46 18	0 54	10 0	59 5 18	1 49

The eighth Rumbe from the meridian. } East: West.

Latitude.		1. deg. of lon.			Differ.		Latitude.		1. deg. of lon.			Differ.	
Deg.	Mi.	min.	sec.	thir.	sec.	thir.	Deg.	Mi.	min.	sec.	thir.	sec.	thir.
10	10	59	3	28	1	50	15	10	57	54	36	2	44
10	20	59	1	37	1	51	15	20	57	51	51	2	45
10	30	58	59	43	1	54	15	30	57	49	4	2	47
10	40	18	57	49	1	54	15	40	57	46	15	2	49
10	50	58	55	50	1	59	15	50	57	43	25	2	50
11	0	58	53	51	1	59	16	0	57	40	33	2	52
11	10	58	51	51	2	0	16	10	57	37	38	2	55
11	20	58	49	48	2	3	16	20	57	34	43	2	55
11	30	58	47	44	2	4	16	30	57	31	45	2	58
11	40	58	45	38	2	6	16	40	57	28	46	2	59
11	50	58	43	30	2	8	16	50	57	25	45	3	1
12	0	58	41	20	2	10	17	0	57	22	42	3	3
12	10	58	39	8	2	12	17	10	57	19	37	3	5
12	20	58	36	55	2	13	17	20	57	16	31	3	6
12	30	58	34	40	2	15	17	30	57	13	23	3	8
12	40	58	32	23	2	17	17	40	57	10	13	3	10
12	50	58	30	4	2	19	17	50	57	7	2	3	11
13	0	58	27	44	2	20	18	0	57	3	48	3	14
13	10	58	25	22	2	22	18	10	57	0	33	3	15
13	20	58	22	58	2	24	18	20	56	57	16	3	17
13	30	58	20	32	2	26	18	30	56	53	58	3	18
13	40	58	18	4	2	28	18	40	56	50	38	3	20
13	50	58	15	35	2	29	18	50	56	47	16	3	22
14	0	58	13	4	2	31	19	0	56	43	52	3	24
14	10	58	10	31	2	33	19	10	56	40	27	3	25
14	20	58	7	56	2	35	19	20	56	36	59	3	28
14	30	58	5	20	2	36	19	30	56	33	31	3	28
14	40	58	2	42	2	38	19	40	56	30	0	3	31
14	50	58	0	2	2	40	19	50	56	26	28	3	32
15	0	57	57	20	2	42	20	0	56	22	54	3	34

The eighth Rumbe from the meridian. } East: West.

Latitude.	1. deg of lon.	Differ.	Latitude.	1. deg. of lon.	Differ.
Deg. Mi	min. sec. thir	sec. thir	Deg. Mi.	min. sec. thir.	sec. thir.
20 10	56 19 18	3 36	25 10	54 18 16	4 26
20 20	56 15 40	3 38	25 20	54 13 48	4 28
20 30	56 12 1	3 39	25 30	54 9 18	4 30
20 40	56 8 20	3 41	25 40	54 4 47	4 31
20 50	56 4 38	3 42	25 50	54 0 14	4 33
21 0	56 0 53	3 45	26 0	53 55 40	4 34
21 10	55 57 7	3 46	26 10	53 51 3	4 37
21 20	55 53 20	3 47	26 20	53 46 25	4 38
21 30	55 49 30	3 50	26 30	53 41 46	4 39
21 40	55 45 39	3 51	26 40	53 37 5	4 41
21 50	55 41 48	3 51	26 50	53 32 22	4 43
22 0	55 37 52	3 56	27 0	53 27 37	4 45
22 10	55 33 55	3 57	27 10	53 22 51	4 46
22 20	55 29 58	3 57	27 20	53 18 4	4 47
22 30	55 25 58	4 0	27 30	53 13 14	4 50
22 40	55 21 57	4 1	27 40	53 8 23	4 51
22 50	55 17 54	4 3	27 50	53 3 31	4 52
23 0	55 13 49	4 5	28 0	52 58 37	4 54
23 10	55 9 43	4 6	28 10	52 53 41	4 56
23 20	55 5 35	4 8	28 20	52 48 44	4 57
23 30	55 1 25	4 10	28 30	52 43 44	5 0
23 40	54 57 14	4 11	28 40	52 38 44	5 0
23 50	54 53 1	4 13	28 50	52 33 42	5 2
24 0	54 48 46	4 15	29 0	52 28 38	5 4
24 10	54 44 29	4 17	29 10	52 23 32	5 6
24 20	54 40 11	4 18	29 20	52 18 25	5 7
24 30	54 35 52	4 19	29 30	52 13 17	5 8
24 40	54 31 30	4 22	29 40	52 8 7	5 10
24 50	54 27 07	4 23	29 50	52 2 55	5 12
25 0	54 22 42	4 25	30 0	51 57 41	5 14

The eighth Rumbe from the meridian. } East: West.

Latitude.		1. deg. of lon.			Differ.		Latitude.		1. deg. of lon.			Differ.	
Deg.	Mi.	min.	sec.	thir.	sec.	thir.	Deg.	Mi.	min.	sec.	thir.	sec.	thir.
30	10	51	52	26	5	15	35	10	49	2	56	6	1
30	20	51	47	10	5	16	35	20	48	56	53	6	3
30	30	51	41	52	5	18	35	30	48	50	49	6	4
30	40	51	36	32	5	20	35	40	48	44	43	6	6
30	50	51	31	11	5	21	35	50	48	38	36	6	7
31	0	51	25	48	5	23	36	0	48	32	28	6	8
31	10	51	20	24	5	24	36	10	48	26	18	6	10
31	20	51	14	58	5	26	36	20	48	20	6	6	12
31	30	51	9	30	5	28	36	30	48	13	53	6	13
31	40	51	4	1	5	29	36	40	48	7	39	6	14
31	50	50	58	31	5	30	36	50	48	1	23	6	16
32	0	50	52	58	5	33	37	0	47	55	5	6	18
32	10	50	47	25	5	33	37	10	47	48	46	6	19
32	20	50	41	47	5	36	37	20	47	42	26	6	20
32	30	50	36	13	5	36	37	30	47	36	4	6	22
32	40	50	30	34	5	39	37	40	47	29	41	6	23
32	50	50	24	54	5	40	37	50	47	23	16	6	25
33	0	50	19	13	5	41	38	0	47	16	50	6	26
33	10	50	13	30	5	43	38	10	47	10	23	6	27
33	20	50	7	45	5	45	38	20	47	3	54	6	29
33	30	50	1	59	5	46	38	30	46	57	23	6	31
43	40	49	56	12	5	47	38	40	46	50	52	6	31
33	50	49	50	23	5	49	38	50	46	44	18	6	34
34	0	49	44	32	6	51	39	0	46	37	44	6	34
34	10	49	38	40	5	52	39	10	46	31	7	6	37
34	20	49	32	46	5	54	39	20	46	24	30	6	37
34	30	49	26	51	5	55	39	30	46	17	51	6	39
34	40	49	20	55	5	56	39	40	46	11	11	6	40
34	50	49	14	56	5	59	39	50	46	4	29	6	42
35	0	49	8	57	5	59	40	0	45	57	46	6	43

The eighth rumbe from the meridian. } East: West.

Latitude.	1. deg. of lon.	Differ.	Latitude.	1. deg. of lon.	Differ.
Deg. Mi.	min. sec. thir.	sec. thir.	Deg. Mi.	min. sec. thir.	sec. thir.
40 10	45 51 1	6 45	45 10	42 18 10	7 25
40 20	47 44 15	6 46	45 20	42 10 44	7 26
40 30	45 37 28	6 47	45 30	42 3 16	7 28
40 40	45 30 39	6 49	45 40	41 55 48	7 28
40 50	45 23 49	6 50	45 50	41 48 18	7 30
41 0	45 16 57	6 50	46 0	41 40 46	7 32
41 10	45 10 4	6 53	46 10	41 33 14	7 32
41 20	45 3 10	6 54	46 20	41 25 40	7 34
41 30	44 56 14	6 56	46 30	41 18 6	7 34
41 40	44 49 17	6 57	46 40	41 10 28	7 38
41 50	44 42 19	6 58	46 50	41 2 51	7 37
42 0	44 35 19	7 0	47 0	40 55 12	7 39
42 10	44 28 18	7 1	47 10	40 47 32	7 40
42 20	44 21 16	7 2	47 20	40 39 50	7 42
42 30	44 14 12	7 4	47 30	40 32 7	7 43
42 40	44 7 7	7 5	47 40	40 24 24	7 43
42 50	43 0 0	7 7	47 50	40 16 39	7 45
43 0	43 52 52	7 8	48 0	40 8 52	7 47
43 10	43 45 43	7 9	48 10	40 1 5	7 47
43 20	43 38 33	7 10	48 20	39 53 16	7 49
43 30	43 31 21	7 12	48 30	39 45 26	7 50
43 40	43 24 8	7 13	48 40	39 37 35	7 51
43 50	43 16 53	7 15	48 50	39 29 42	7 53
44 0	43 9 37	7 16	49 0	39 21 49	7 53
44 10	43 2 20	7 17	49 10	39 13 54	7 53
44 20	42 55 2	7 18	49 20	39 5 58	7 55
44 30	42 47 42	7 20	49 30	38 58 1	7 57
44 40	42 40 21	7 21	49 40	38 50 2	7 59
44 50	42 32 59	7 22	49 50	38 42 3	7 59
45 0	42 25 35	7 24	50 0	38 34 2	8 1

The eighth Rumbe from the meridian } East: West.

Latitude.	1. deg. of lon.	Differ.	Latitude.	1. deg. of lon.	Differ.
Deg. Mi.	min. sec. thir.	sec. thir.	Deg. Mi.	min. sec. thir.	sec. thir.
50 10	38 26 0	8 2	55 10	34 16 17	8 36
50 20	38 17 57	8 3	55 20	34 7 41	8 36
50 30	38 9 53	8 4	55 30	33 59 4	8 37
50 40	38 1 47	8 6	55 40	33 50 25	8 39
50 50	37 53 41	8 6	55 50	33 41 46	8 39
51 0	37 45 33	8 8	56 0	33 33 6	8 40
51 10	37 37 24	8 9	56 10	33 24 24	8 42
51 20	37 29 14	8 10	56 20	33 15 42	8 42
51 30	37 21 3	8 11	56 30	33 6 58	8 44
51 40	37 12 52	8 12	56 40	32 58 14	8 44
51 50	37 4 37	8 14	56 50	32 49 28	8 46
52 0	36 56 23	8 14	57 0	32 40 42	8 46
52 10	36 48 7	8 16	57 10	32 31 55	8 47
52 20	36 39 50	8 17	57 20	32 23 6	8 49
52 30	36 31 32	8 18	57 30	32 14 17	8 49
52 40	36 23 13	8 19	57 40	32 5 26	8 51
52 50	36 14 53	8 20	57 50	31 56 35	8 51
53 0	36 6 32	8 21	58 0	31 47 43	8 52
53 10	35 58 10	8 22	58 10	31 38 49	8 54
53 20	35 49 46	8 24	58 20	31 29 55	8 54
53 30	35 41 22	8 24	58 30	31 21 0	8 55
53 40	35 32 56	8 26	58 40	31 12 3	8 57
53 50	35 24 29	8 27	58 50	31 3 6	8 57
54 0	35 16 2	8 27	59 0	30 54 8	8 58
54 10	35 7 33	8 29	59 10	30 45 9	8 59
54 20	34 59 3	8 30	59 20	30 36 9	9 0
54 30	34 50 32	8 31	59 30	30 27 8	9 1
54 40	34 42 0	8 32	59 40	30 18 6	9 2
54 50	34 33 27	8 33	59 50	30 9 4	9 2
55 0	34 24 53	8 34	60 0	30 0 0	9 4

The eighth Rumbe from the meridian. } East: West.

Latitude.	1. deg. of lon.	Differ.	Latitude.	1. deg. of lon.	Differ.
Deg. Mi.	min. sec. thir	sec. thir.	Deg. Mi	min. sec. thir.	sec. thir.
60 10	29 50 55	9 5	65 10	25 11 56	9 30
60 20	29 41 50	9 5	65 20	25 2 25	9 31
60 30	29 32 43	9 7	65 30	24 52 54	9 31
60 40	29 23 36	9 7	65 40	24 43 22	9 32
60 50	29 14 28	9 8	65 50	24 33 49	9 33
61 0	29 5 19	9 9	66 0	24 24 15	9 34
61 10	28 56 09	9 10	66 10	24 14 41	9 34
61 20	28 46 58	9 11	66 20	24 5 6	9 35
61 30	28 37 46	9 12	66 30	23 55 30	9 36
61 40	28 28 34	9 12	66 40	23 45 53	9 37
61 50	28 19 20	9 14	66 50	23 36 16	9 37
62 0	28 10 06	9 14	67 0	23 26 38	9 38
62 10	28 0 51	9 15	67 10	23 16 59	9 39
62 20	27 51 35	9 16	67 20	23 7 20	9 39
62 30	27 42 18	9 17	67 30	22 57 40	9 40
62 40	27 33 00	9 18	67 40	22 47 59	9 41
62 50	27 23 41	9 19	67 50	22 38 17	9 42
63 0	27 14 22	9 19	68 0	22 28 35	9 42
63 10	27 5 02	9 20	68 10	22 18 52	9 43
63 20	26 55 41	9 21	68 20	22 9 9	9 43
63 30	26 46 19	9 22	68 30	21 59 24	9 45
63 40	26 36 56	9 23	68 40	21 49 39	9 45
63 50	26 27 33	9 23	68 50	21 39 54	9 45
64 0	26 18 08	9 25	69 0	21 30 7	9 47
64 10	26 8 43	9 25	69 10	21 20 21	9 47
64 20	25 59 17	9 26	69 20	21 10 33	9 48
64 30	25 49 50	9 27	69 30	21 0 45	9 48
64 40	25 40 23	9 27	69 40	20 50 56	9 49
64 50	25 30 55	9 28	69 50	20 41 6	9 50
65 0	25 21 26	9 29	70 0	20 31 16	9 50

The eighth Rumbe from the meridian. { *East:* / *West.*

Latitude.	1. deg. of lon.	Differ.	Latitude.	1. deg. of lon.	Differ.
Deg. Mi.	min. sec. thir.	sec. thir.	Deg. Mi.	min. sec. thir.	sec. thir.
70 10	20 21 26	9 50	75 10	15 21 38	10 7
70 20	20 11 34	9 52	75 20	15 11 30	10 8
70 30	20 1 42	9 52	75 30	15 1 22	10 8
70 40	19 51 50	9 52	75 40	14 51 14	10 8
70 50	19 41 56	9 54	75 50	14 41 5	10 9
71 0	19 32 3	9 54	76 0	14 30 55	10 10
71 10	19 22 8	9 55	76 10	14 20 45	10 10
71 20	19 12 13	9 55	76 20	14 10 35	10 10
71 30	19 2 17	9 56	76 30	14 0 24	10 11
71 40	18 52 22	9 55	76 40	13 50 13	10 11
71 50	18 42 25	9 57	76 50	13 40 1	10 12
72 0	18 32 28	9 57	77 0	13 29 49	10 12
72 10	18 22 30	9 58	77 10	13 19 37	10 12
72 20	18 12 31	9 59	77 20	13 9 24	10 13
72 30	18 2 23	9 59	77 30	12 59 11	10 13
72 40	17 52 33	9 59	77 40	12 48 57	10 14
72 50	17 42 33	10 0	77 50	12 38 43	10 14
73 0	17 32 32	10 1	78 0	12 28 29	10 14
73 10	17 22 31	10 1	78 10	12 18 14	10 15
73 20	17 12 29	10 2	78 20	12 7 59	10 15
73 30	17 2 27	10 2	78 30	11 57 43	10 16
73 40	16 52 24	10 3	78 40	11 47 27	10 16
73 50	16 42 21	10 3	78 50	11 37 11	10 16
74 0	16 32 18	10 3	79 0	11 26 55	10 16
74 10	16 22 13	10 3	79 10	11 16 37	10 18
74 20	16 12 9	10 4	79 20	11 6 20	10 17
74 30	16 2 3	10 6	79 30	10 56 3	10 17
74 40	15 51 58	10 5	79 40	10 45 45	10 18
74 50	15 41 52	10 6	79 50	10 35 27	10 18
75 0	15 31 45	10 7	80 0	10 25 08	10 19

The eighth rumbe from the meridian. } East: West.

Latitude.	1. deg. of lon.	Differ.	Latitude.	1. deg. of lon.	Differ.
Deg. Mi.	min. sec. thir.	sec. thir.	Deg. Mi.	min. sec. thir.	sec. thir.
80 10	10 14 49	10 19	85 10	5 3 20	10 26
80 20	10 4 30	10 19	85 20	4 52 53	10 27
80 30	9 54 10	10 20	85 30	4 42 27	10 26
80 40	9 43 50	10 20	85 40	4 32 1	10 26
80 50	9 33 30	10 20	85 50	4 21 34	10 27
81 0	9 23 10	10 20	86 0	4 11 7	10 27
81 10	9 12 49	10 21	86 10	4 0 41	10 26
81 20	9 2 28	10 21	86 20	3 50 14	10 27
81 30	8 52 7	10 21	86 30	3 39 46	10 28
81 40	8 41 45	10 22	86 40	3 29 19	10 27
81 50	8 31 23	10 22	86 50	3 18 52	10 27
82 0	8 21 1	10 22	87 0	3 8 25	10 27
82 10	8 10 39	10 22	87 10	2 57 57	10 28
82 20	8 0 16	10 23	87 20	2 47 29	10 28
82 30	7 49 54	10 22	87 30	2 37 2	10 27
82 40	7 39 31	10 23	87 40	2 26 34	10 28
82 50	7 29 7	10 24	87 50	2 16 6	10 28
83 0	7 18 44	10 23	88 0	2 5 38	10 28
83 10	7 8 20	10 24	88 10	1 55 10	10 28
83 20	6 57 56	10 24	88 20	1 44 42	10 28
83 30	6 47 32	10 24	88 30	1 34 14	10 28
83 40	6 37 8	10 24	88 40	1 23 46	10 28
83 50	6 26 43	10 25	88 50	1 13 18	10 28
84 0	6 16 18	10 25	89 0	1 2 50	10 28
84 10	6 5 53	10 25	89 10	0 52 21	10 29
84 20	5 55 28	10 25	89 20	0 41 53	10 28
84 30	5 45 3	10 25	89 30	0 31 25	10 28
84 40	5 34 37	10 26	89 40	0 20 56	10 29
84 50	5 24 10	10 27	89 50	0 1 28	10 28
85 0	5 13 46	10 27	90 0	0 0 0	0 0

CHAP. X.

The vſe of this Table of Rumbs.

THe eſpeciall vſe of this table is for the true drawing of the rumbes in the globe and in the chart, which ſome (with a name aſtoniſhing with an emptie ſound) call paradoxall: but to ſpeake plaine engliſh, it is nothing elſe but a chart, whoſe center is the pole, and may beſt bee made after the kinde of proiection vſed by *Gemma Friſius* in his generall Aſtrolabe: wherein the meridians will be right lines paſſing by the center, and the parallels peripheries of a circle: ſuppoſing one halfe of the ſphæricall ſuperficies of the terreſtriall globe to be proiected into the plaine of the æquinoctial. Whoſe principall vſe may be in our Northerly nauigations and diſcoueries, wherein the rumbes may moſt eaſily and truly be drawne by helpe of this table, thus: Hauing an Index hanged vpon the center, and graduated with degrees of latitude, with figures ſet to euerie fifth or tenth degree, beginning at the æquinoctiall: hauing alſo diuided the æquinoctiall into degrees of longitude, beginning at the firſt meridian, lay the Index to euery degree of longitude in order one after another; looking alwaies withall in this Table, the latitudes of the rumbe you deſire to deſcribe, and at the ſame latitudes found in the fiduciall line of the Index, make pricks in the chart, for by theſe pricks, the hæliſphæricall line or rumbe deſired muſt be drawne.

After

After the same manner must you worke with the Globe, hauing first truly hanged it vpon his poles within his meridian diuided into degrees, and subdiuided also into smaller parts (if roome will serue) with numbers set to euery fifth, or tenth degree frō the æquinoctiall to the Pole, and then proceeding in all points, as before you did, with the chart, only vsing the Meridian in stead of the Index.

Hereby also the rumbes may most exactly be described in those distorted hart-formed maps of *Orontius* and *Vopelius*, or in any other amongst *Ptolemees* or *Ortelius* his Geographical Tables, or any else whatsoeuer, so it be first distinguished by meridians & parallels, wherby the longitude & latitude of any point assigned therein may be readily found; seeing it may easily be knowne out of this Table by what points of longitude and latitude each rumbe must be drawne from the æquinoctial to the Pole almost. But those two kindes of proiection before mentioned, I meane of the nauticall Planisphære, and *Gemma Frisius* his Astrolabe, are such as of all others doe best represent in a plaine, the true formes of all places that are vpon the sphæricall face of the earth.

The vse of the table of the eighth rumbe.

The table of the eighth Rumbe serueth to shew how many minutes, seconds and thirds of one degree of the æquinoctiall, are conteined in one degree of longitude for euery tenth minute of latitude: whereby the whole table of Rumbs may be made and examined more truly, and easily, then by that of *Appian*, lately set foorth by *Simon Steuin* in his *Hypomnemat. Mathemat.*

Chap. XI.

A moſt plaine and ſenſible demonſtration of the agreement of the Nauticall Planiſphære, before deſcribed, with the Globe; and of the diſagreement of the common Sea-chart from them both.

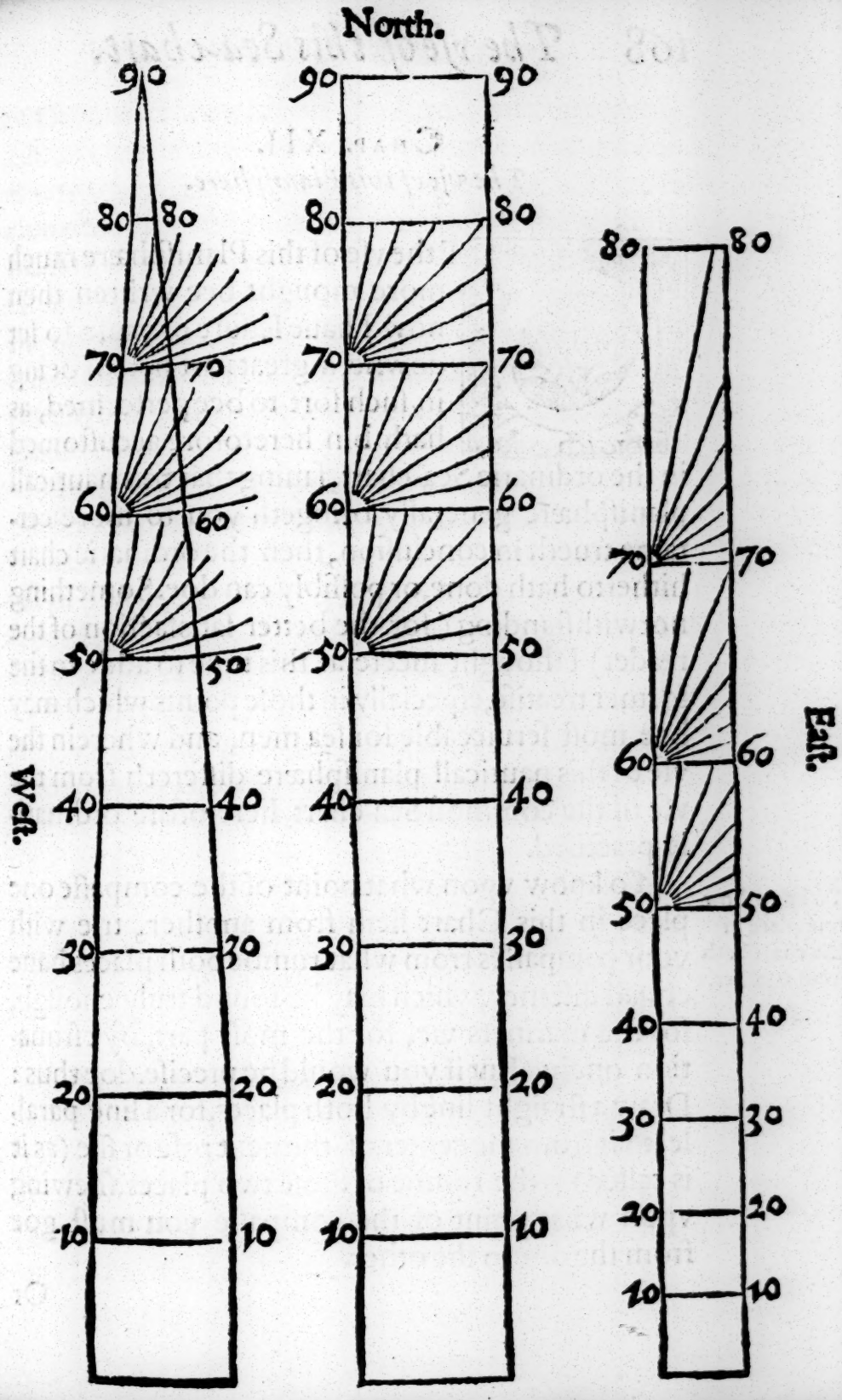
HAuing thus ſhewed the manifold vſes of the table of Latitudes, aſwell for ỹ true graduating of Sea-charts both generall and particular, with degrees of latitude increaſing in their due proportion, as alſo for the making of the table of Rumbes, together with the vſe thereof; I will now come againe to the matter, and marke principally intended and aimed at in this firſt book, and ſhew how greatly the common Sea-chart (with parallel meridians and degrees of latitude euerie where equal) doth differ from the truth, as alſo how well the chart, before deſcribed, agreeth with the ſame; which may moſt manifeſtly appeare by comparing together theſe three figures following, whereof the firſt is in all points anſwerable to a part of a ſphæricall ſuperficies, conteined betwixt two meridians, differing in longitude ten degrees, and extended from the æquinoctiall to the Pole. The ſecond conteineth ten degrees in longitude, and 90 degrees from the æquinoctiall in latitude, of the common Sea-chart with equidiſtant meridians and degrees of latitude euery where equall. The third conteineth 10 degrees in longitude, and 80 in latitude of the nauticall Planiſphære, truly deſcribed with

with meridians in all places æquidiſtant, and degrees of latitude increaſing proportionally towards the pole, as before we haue ſhewed.

Now all the other parts of the Globe or Charts are like vnto theſe; therefore what agreement or diſagreement is found in theſe parts muſt needes be alſo in their wholes. The firſt figure is a part of the Globe, and therefore in all things ſheweth the very trueth: therefore wee make it the rule to examine the reſt by, for ſo farre forth as they agree with it, they are true, and as much as they differ from it, they are falſe. Now therefore let vs bring them to examination.

If there be two places differing in longitude and latitude 10 degrees (that which hath the greater latitude being more to the Eaſtwards) the ſecond figure (as you ſee) maketh them lie each from other Northeaſt and Southweſt, in what latitude ſoeuer they be ſituate, either neerer or further from the æquinoctiall, as in 50 and 60, or in 60 and 70; or in 70 and 80 degrees of latitude. But in the firſt and third figure, theſe places ſhall beare almoſt Northeaſt and Southweſt each from other, at the æquinoctiall onely. And one place being ſituate in 50, and the other in 60 degrees of latitude, they ſhall lie one from another Northeaſt and by North, and almoſt halfe a point Northerly. In 60 and 70 degrees of latitude they lie almoſt North Northeaſt: in 70 and 80 they beare each from other ſcarce ſo much as North and by Eaſt. Therefore the common Sea-chart, in ſhewing how one of thoſe places beareth from another, erreth in the firſt one point of the

compaſſe and almoſt an halfe; in the ſecond, two whole points almoſt; but in the third, more then three whole points. Neither is it poſſible to auoide theſe ſo groſſe and intollerable errors (if the rumbs be right lines, and the degrees of longitude and latitude euery where equall) but wee muſt needes fall into other errors as groſſe as theſe, either in the difference of longitudes, or in the differenee of latitudes, or in the reſpectiue ſituation, which they commonly call, the lying or bearing of them one from another, as may moſt plainly appeare by comparing the common ſea-chart and the Globe together. But in this nauticall planiſphære heretofore deſcribed, all theſe errors are auoided, aſwell in the longitudes and latitudes, as alſo in the directionall diſtances and reſpectiue ſituations of all places, each from other according to the points of the compaſſe, as by like compariſon of it with the Globe, will be moſt manifeſt.


North.
90
80
70
60
50
40
30
20
10
West.
East.

Chap. XII.
The vse of this Planisphære.

OF the vse of this Planisphære much more mought bee written then now I haue leisure or cause to set downe, a great part hereof being in such sort to bee performed, as hath bin heretofore accustomed in the ordinarie Sea-chart, sauing that this nauticall planisphære generally bringeth you to more certaine trueth in conclusion, then the ordinarie chart hitherto hath done, or possibly can doe. Something notwithstanding (for the better satisfaction of the reader) I thought meete at this time to adde to the former treatise, especially in those points which may bee most seruiceable for sea men, and wherein the vse of this nauticall planisphære differeth from the vse of the common Sea-chart, heretofore ordinarily practised.

To know how one place in the chart lieth from another.

To know vpon what point of the compasse one place in this Chart lieth from another, trie with your compasses from what rumbe both places haue equall distance, which may be found truly enough, for the mariners vse, for the most part, by estimation onely. But if you would be precise, doe thus: Draw a straight line by both places, for a line parallel to it from the center of the next rose or flie (as it is called) is the rumbe of those two places, shewing vpon what point of the compasse you must goe from the one to the other.

Or

Or thus, (if you list not draw any lines vpon your Chart) lay the edge of a long ruler (reaching ouerthwart the Chart) to both places: take with your compasses the distance of the center of the next flie from the edge of the ruler, then guiding and carrying one foote along by the edge of the ruler, leade the other foote parallel-wise (that is, keeping it alwaies equally at that distance from the ruler) for so it sheweth you how those places lie one from another.

To finde the distance of places in their rumbe.

The distance of two places (as the mariners commonly take it, and measure it in their Charts) is the segment or part of the rumbe conteined betweene them; which how much it is in the ordinarie measure of leagues, shall truly be found out by this planisphære, thus:

If both places haue one latitude.

If both places haue the same latitude, take with your compasses the length of a degree of the meridian at that latitude (take halfe the degree aboue, and halfe beneath that latitude) for so oft as you shall finde that length betweene the two places, so many score leagues are there betwixt them. If the distance bee great, for the more expedition, you may take fiue times the length of that degree, and counting it for an hundred leagues, proceed as before.

If both places haue the same longitude.

If both places haue not the same latitude, the equinoctial also not comming betweene them, subtract the lesser latitude out of the greater; but if the æquinoctiall come betwixt them, adde both latitudes together, so haue you the difference of latitude betweene both places.

Now if both places haue the ſame longitude, ſo many degrees as there is in the difference of latitude, ſo many ſcore leagues is the diſtance.

If both places differ both in longitude and latitude.

But if they differ alſo in longitude as well as in latitude, looke how many degrees the difference of latitude containeth, ſo many degrees of the æquinoctiall take with your compaſſes, and leading one foote in the æquinoctiall, moue forwards the other alſo parallel-wiſe, keeping alwaies that diſtance, till it croſſe the rumbe of thoſe two places, in ſuch ſort, that one foote reſting in that croſſing, the other caried about, may but onely touch the æquinoctiall. Then hauing taken with your compaſſes the ſegment or part of that rumbe betweene that croſſing and the æquinoctiall, ſet both feete in the æquinoctiall, and ſee how many degrees are contained betwixt them, for ſo many ſcore leagues is the diſtance of thoſe two places.

Or if that ſegment of the ſaid rumbe bee greater then well can be taken with the compaſſes, take the length of fiue degrees of the æquinoctiall, between the feete of your compaſſes, and looke how oft you can finde that length in the ſegment aforeſaid of the rumbe, for ſo many hundreth leagues is the diſtance of thoſe two places.

The demonſtration of the truth of the former rules.

The demonſtration hereof cannot be obſcure to him that well conſidereth the geometricall reaſon of the proiection, and making of this nauticall planiſphære, before ſet downe in the ſecond chapter; from whence it followeth, that becauſe the ſphæricall ſuperficies (whereof this planiſphære is conceiued to bee geometrically made) extendeth it ſelfe

euery

euery way equally, at euery point of latitude betwixt the æquinoctiall and pole, till it applie and ioyne it selfe round about to the concauitie of the circumscribed cylinder, therefore the segments of the meridian, and of any other rumbe contained betwixt any the same two parallels, must needs increase in one and the same proportion.

And consequently, as often as the segment of a meridian betweene any two parallels, is contained in the segment of any rumbe intercepted betwixt the same parallels in the Globe, so often is the like segment of a meridian contained in the segment of the same rumbe intercepted betweene the parallels correspondent in this planisphære. Therefore (supposing the said segment of the meridian in this planisphære, to be diuided into so many equall parts as it containeth degrees) it followeth, that so often as one of these parts is contained in the segment of the rumbe aforesaid in this planisphære, so many score leagues is the distance of the two places set at the ends of that segment.

Now it is manifest, that by these three segments, that is, the segment of the rumbe betweene the two places, the segment of the meridian betwixt one of the places, and the parallel of the other (that is, the difference of latitude) and the segment of the parallel contained betwixt one of these places, and the meridian of the other (which is the difference of longitude) I say it is manifest, that by these three segments a right angled triangle is made, because the segments of the meridian and parallel (which are two sides of this triangle) include a right angle.

Againe

Againe it is plaine, that taking with your com paſes ſo many degrees of the æquinoctiall as are conteined in the difference of latitude: then guiding one foote in the æquinoctiall, and carrying forwards the other parallel-wiſe, till it croſſe the rumbe of thoſe two places, in ſuch ſort, that one foote of the compaſſes being ſet in that croſſing, the other moued about, may but only touch the æquinoctial: and laſtly, drawing from that croſſing a line perpendicular to the æquinoctial: It is plaine, I ſay, that by this perpendicular and the two ſegments (one of the æquinoctial, betweene this perpendicular and the rumbe; the other of the rumbe, betweene the perpendicular and the æquinoctiall): by theſe ſegments, I ſay, and the ſaid perpendicular, there is comprehended another right angled Triangle: which by the 14. *e* 4, *&* *c*. 3. *e*. 7 *Ram.* is like to the former right angled Triangle, becauſe two angles of them both are æquall, that is, the right angles, and the angles of the ſame rumbe. In the laſt of theſe Triangles, the ſide perpendicular to the æquinoctiall, is proportionall to the difference of latitude, and the ſegment of the rumbe betweene the end of this perpendicular and the æquinoctiall, is proportionall to the ſegment of the ſame rumbe conteined betwixt the two places. Therefore by the 2 *p* 6. *&* 17 *p*. 11 *Eucl.* becauſe the line perpendicular to the æquinoctiall, conteineth ſo many equal degrees of the æquinoctiall, as there are equall parts in the difference of latitude (that is) ſo many as there are degrees in the difference of latitude: theſe equall parts alſo of the perpendicular and difference

rence of latitude are proportionall. Whereof it followeth, that so oft as one of these equall parts of the difference of latitude is conteined in the segment of the rumbe betwixt the two places (which before we shewed to be so oft as a degree of the meridian in the globe, is conteined in the segment of the rumbe betwixt the same places in the globe) so oft is one of the said equall parts of the perpendicular aforesaid (that is a degree of the æquinoctiall) conteined in the segment of the same rumbe betweene the foresaid crossing or end of the perpendicular, and the æquinoctiall. Therefore look how many degrees of the æquinoctiall there are found in the segment of the rumbe of the two places, so many score leagues is the distance of those two places, which was to be demonstrated.

Thus haue you a way infallible to finde out the distance between any two places measured in their rumbe: which because it is then onely their true distance (that is the shortest space betwixt them vpon the superficies of the terrestriall globe) when both places lie North and South each from other, or East and West, hauing no latitude, as vnder the æquinoctiall; whereas otherwise the segment of the rumbe betweene the two places is alwaies greater then the true distance (yea sometime by halfe and more, in places far Northward, or Southward) I thought good also here to set downe the way to finde out the true distance of any two places, according to the arch of a great circle drawne betweene them, wherein I haue been, and yet am publikely charged with my promise, and meane at this time to discharge my selfe thereof.

The

The true distance betweene two places, is the arch of a great circle contained betwixt them, which is thus to be found out:

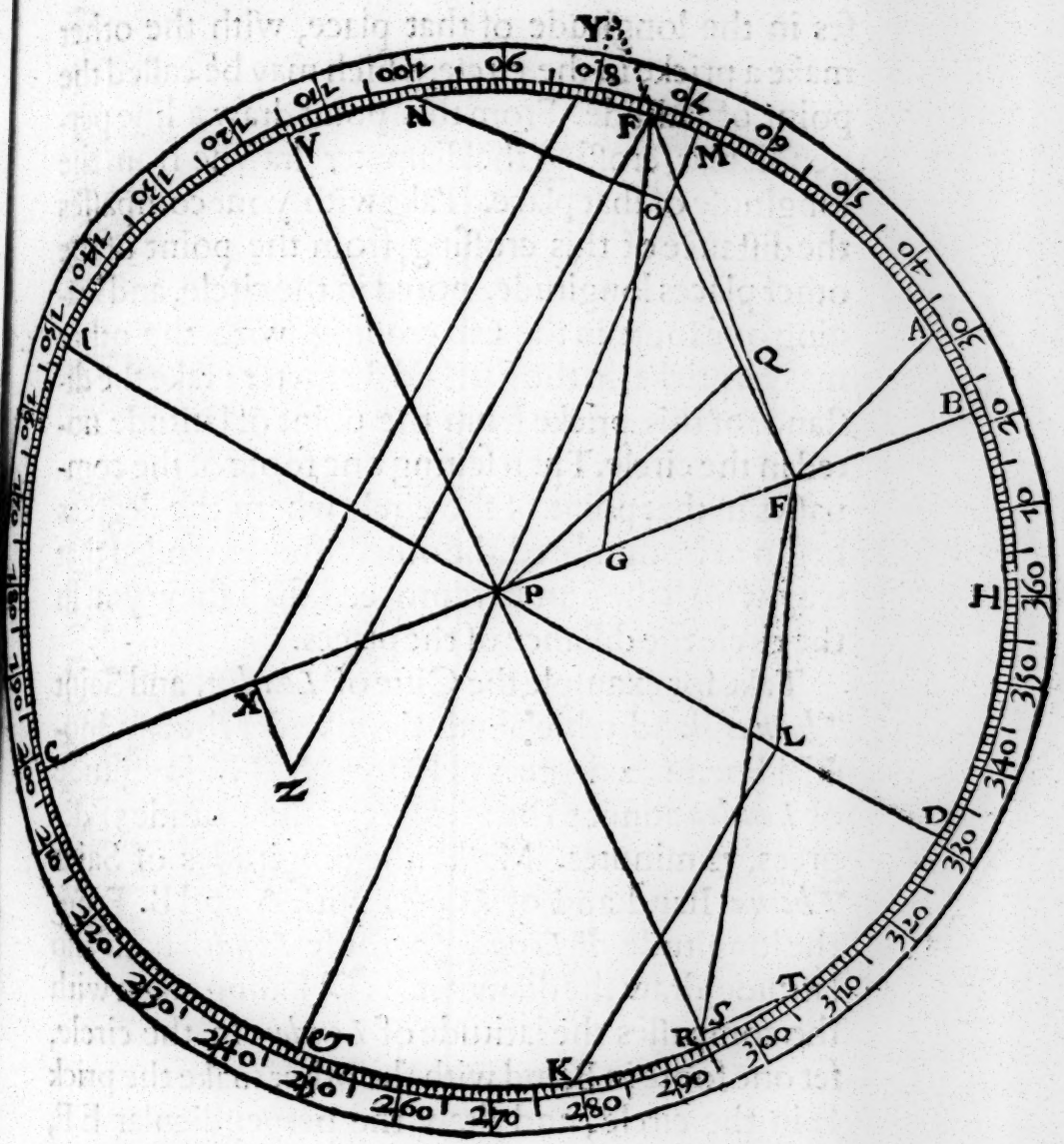
If both places haue no latitude (as when they are both vnder the æquinoctiall) and one of them also no longitude, the longitude of the other being lesse, or not more then 180 degrees; the longitude is the distance;

But if the longitude be greater then 180 degrees, subtract it out of 360; the remainder is the distance.

If both places haue either none, or the same longitude (as when they are in the same semicircle of the meridian betweene the poles) and one of them onely haue latitude; that latitude is the distance. But if both places agreeing in longitude haue latitudes also of like denomination (as both Northerly, or both Southerly) subtract the lesser latitude out of the greater, the distance remaineth: If one place haue Northerly latitude, and the other Southerly, adde them together; for the summe is the distance.

If one or both places haue latitude, and differ also in longitude: in a great circle diuided exactly into degrees (with figures set to euery fifth or tenth degree) note the longitudes of both places.

Now

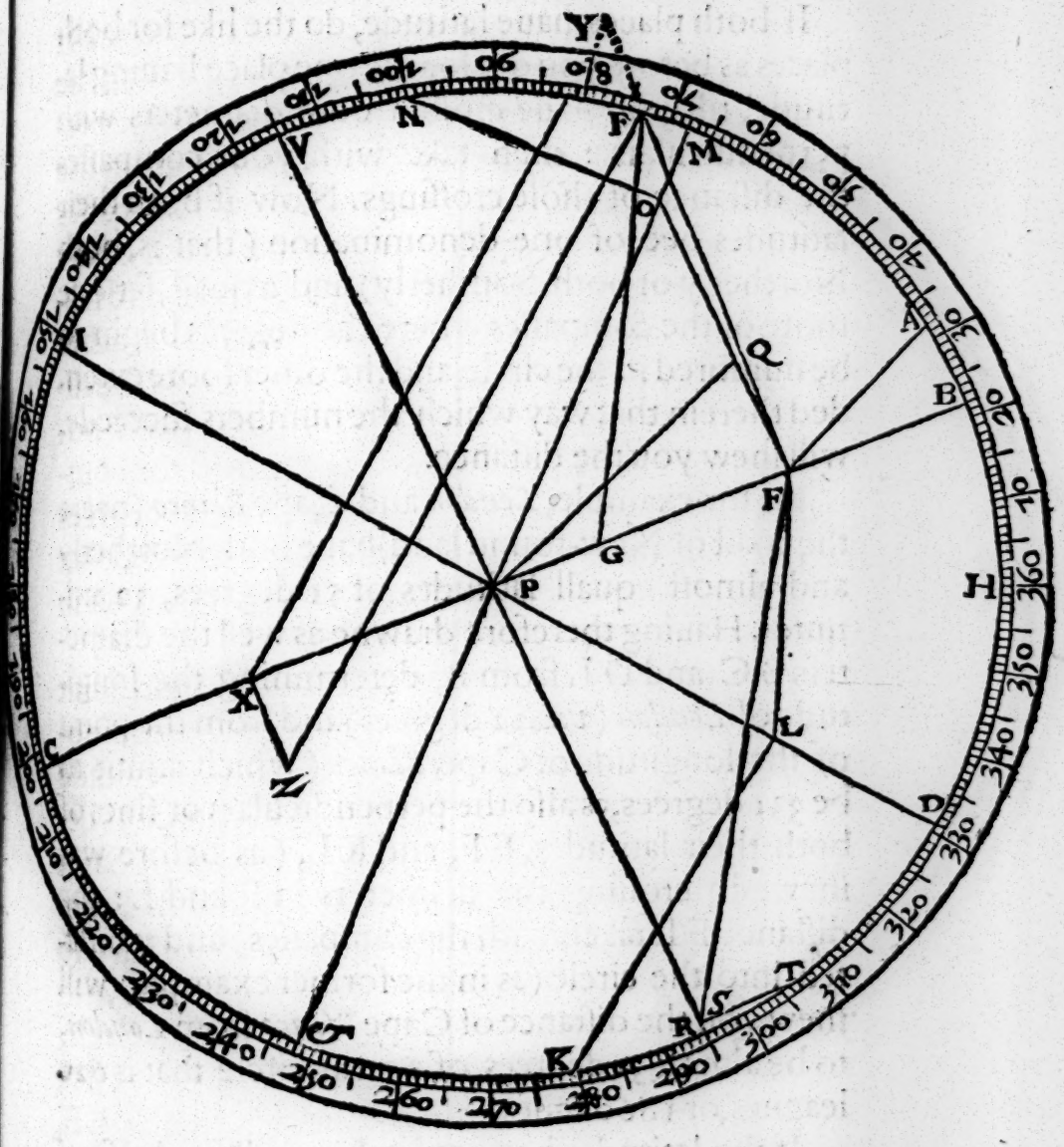


Now if one place only haue latitude, draw a diameter from the longitude thereof, noted in the circle, and with your compaſſes take ſo many degrees and minutes in the ſame circle, as that latitude containeth: then ſetting one foote of the compaſ-

ſes

ſes in the longitude of that place, with the other make a pricke in the circle, which may be called the point of latitude. From this point draw a line perpendicular, croſſing the diameter drawne from the longitude of that place. Take with your compaſſes the diſtance of this croſſing, from the point of the other places longitude, noted in the circle, and leauing one foote in the ſaid croſſing, with the other make a pricke, in the foreſaid diameter: take the diſtance of this pricke from the point of latitude noted in the circle. Then ſetting one foote of the compaſſes in that point of the circle where the degrees begin to be numbred, the other foote extended that way, which the numbers proceed, ſhall ſhew you in the circle the diſtance of the places.

Take for example the Citie of *London*, and Saint *Thomas* Iland, which lieth right vnder the æquinoctial line, in 32 degrees of longitude. The longitude of *London* admit to be 22 degrees, the latitude 51 degrees, 32 minutes. Marke the longitudes of Saint *Thomas* Iland and of *London* with A and B. From the longitude of *London* (becauſe *London* hath alſo latitude) draw the diameter B C. Hauing taken with the compaſſes the latitude of *London* in the circle, ſet one foote in B, and with the other make the prick E in the circle, and draw the perpendicular E F, croſſing the diameter B C at F. Make F G equall to F A, which is the diſtance of Saint *Thomas* Iland from the ſine of *Londons* latitude. Then G E ſhall be the line ſubtending the diſtance of thoſe two places. Taking therefore the length of G E with the compaſſes, and ſetting one foote in H (where the degrees



degrees begin) the other ſtretched forwards in the circle, will point you out the diſtance of Saint *Thomas* Iland and *London*, 52 degrees of a great circle, and about one halfe, that is, 1050 leagues, or 3150 Engliſh miles.

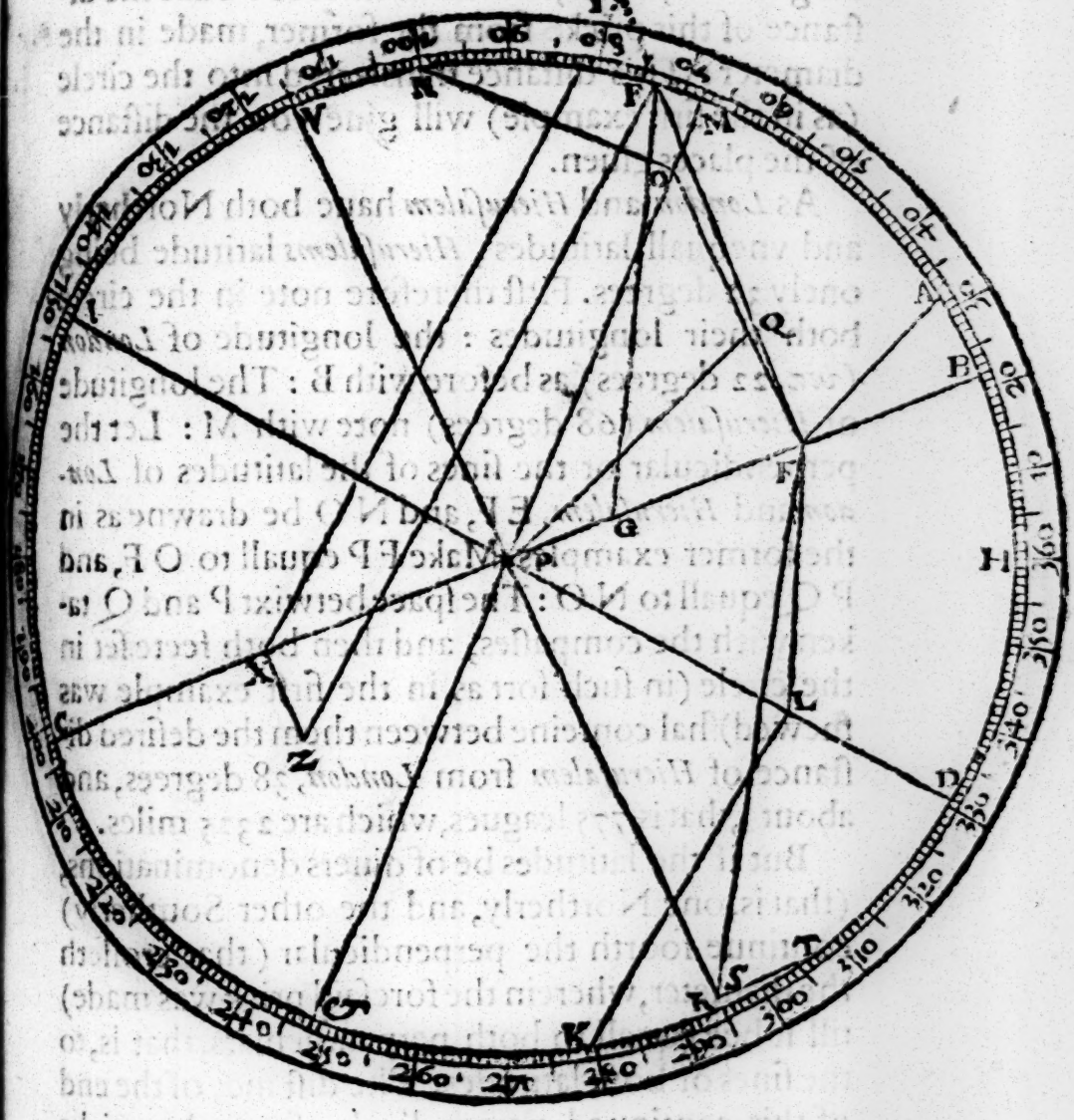
If

If both places haue latitude, do the like for both places as before you did for the one place hauing latitude, till you haue crossed both diameters with perpendiculars: then take with your compasses the distance of those crossings. Now if both their latitudes bee of one denomination (that is, both Northerly or both Southerly) and æquall, set one foote of the compasses where the degrees begin to be numbred in the circle, and the other foote extended therein that way which the numbers succeede, will shew you the distance.

As for example, *London* and Cape *Blanco* (neere the coast of New-found land) haue both Northerly and almost equall latitudes of 51 degrees, 32 minutes. Hauing therefore drawne as well the diameters B C and D L from B, determining the longitude of *London* (*viz.* 22 degrees) and from the point of the longitude of Cape *Blanco* (which admit to be 331 degrees, as also the perpendiculars or sines of both their latitudes, E F, and K L, (as before was shewed) crossing the diameters in F and L: the distance F L taken with the compasses, and translated into the circle (as in the former example) will shew you the distance of Cape *Blanco* from *London*, to be almost 31 degrees, of a great circle that is 620 leagues, or 1860 miles.

If the latitudes bee not both equall, and also of one denomination, leauing one foote of the compasses in the crossing of the sine or perpendicular descending from the point of the greater latitude, with the other foote make a pricke in the same diameter, wherin that crossing is: then if the latitudes

be



be both of one denomination, take with the compasses the length of ẏ perpendicular or line drawne from the point of the lesser latitude: and setting one foote in the point of the greater latitude, with the other make a prick in the perpendicular descen-

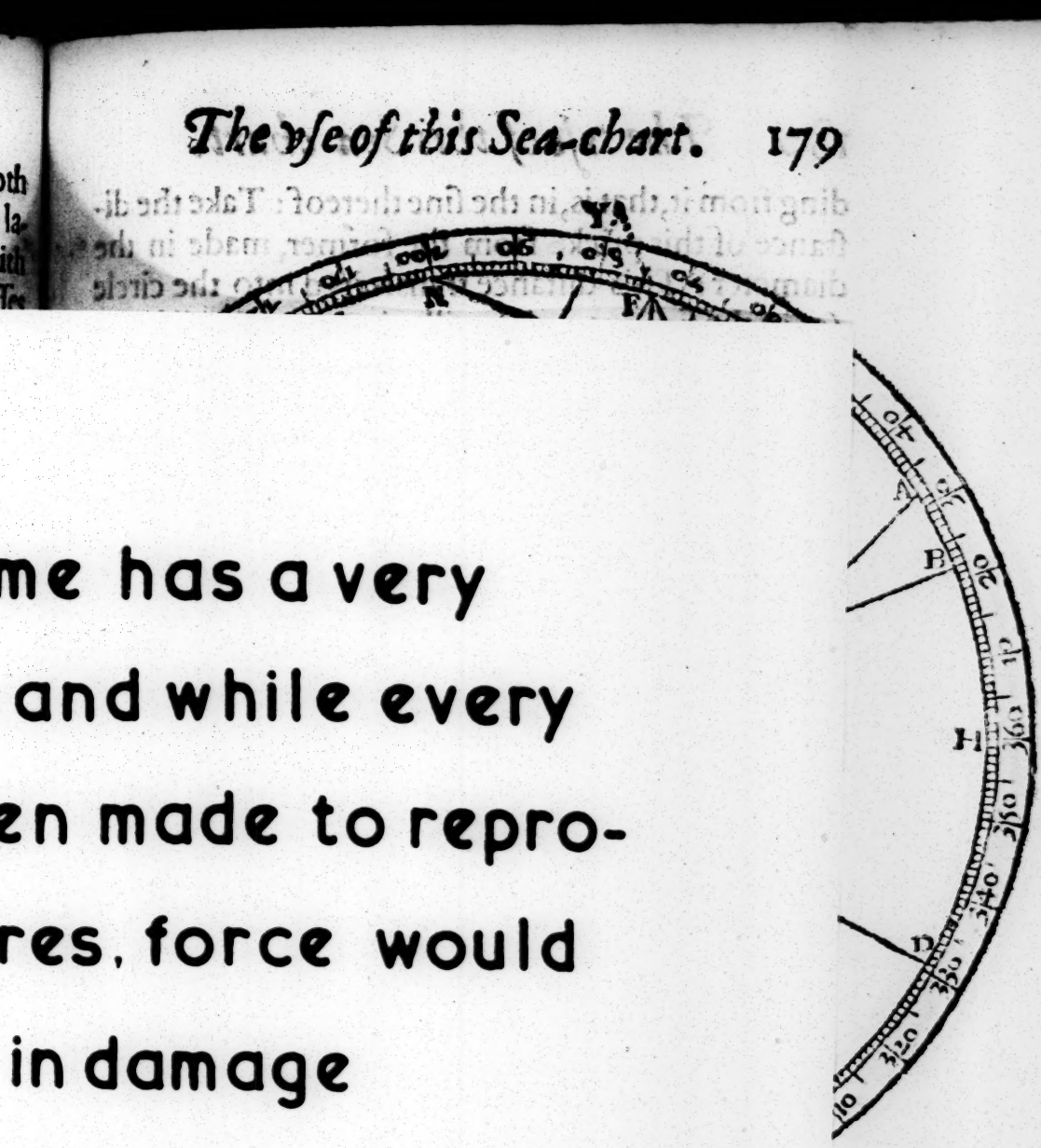
If both places haue latitude, do the like for both places as before you did for the one place hauing latitude, till you haue crossed both diameters with perpendiculars: then take with your compasse

NOTE

This volume
tight binding a
effort has beer
duce the centre
result in

acad
microform

be



me has a very
and while every
en made to repro-
res, force would
in damage

demic
rms

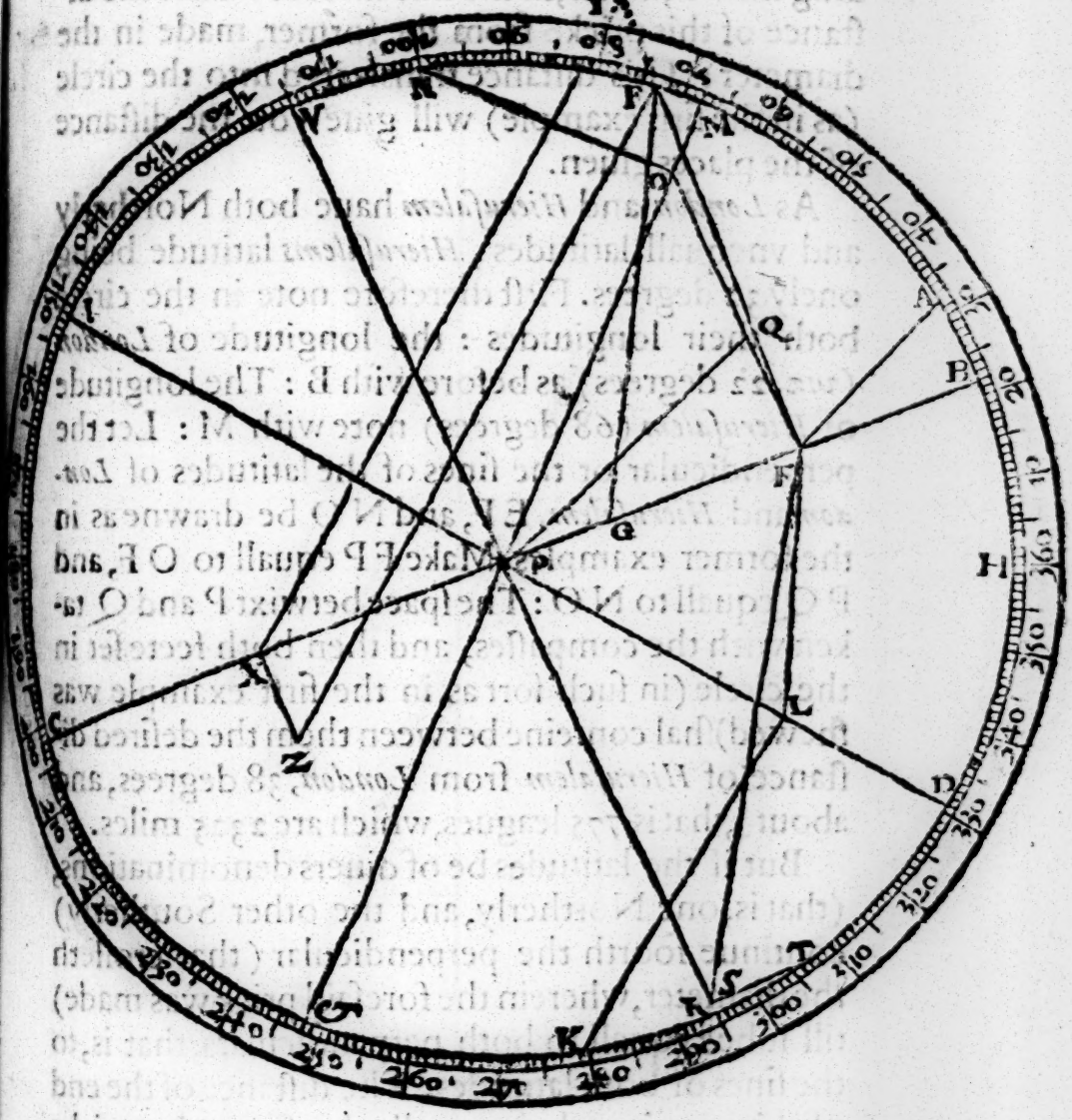
the other make a prick in the perpendicular descen-

If both places haue latitude, do the like for both places as before you did for the one place hauing latitude, till you haue crossed both diameters with perpendiculars: then take with your compasses the distance of those crossings. Now if both their latitudes bee of one denomination (that is, both Northerly or both Southerly) and æquall, set one foote of the compasses where the degrees begin to be numbred in the circle, and the other foote extended therein that way which the numbers succeede, will shew you the distance.

As for example, *London* and Cape *Blanco* (neere the coast of New-found land) haue both Northerly and almost equall latitudes of 51 degrees, 32 minutes. Hauing therefore drawne as well the diameters B C and D L from B, determining the longitude of *London* (*viz.* 22 degrees) and from the point of the longitude of Cape *Blanco* (which admit to be 331 degrees, as also the perpendiculars or sines of both their latitudes, E F, and K L, (as before was shewed) crossing the diameters in F and L: the distance F L taken with the compasses, and translated into the circle (as in the former example) will shew you the distance of Cape *Blanco* from *London*, to be almost 31 degrees, of a great circle that is 620 leagues, or 1860 miles.

If the latitudes bee not both equall, and also of one denomination, leauing one foote of the compasses in the crossing of the sine or perpendicular descending from the point of the greater latitude, with the other foote make a pricke in the same diameter, wherin that crossing is: then if the latitudes

be



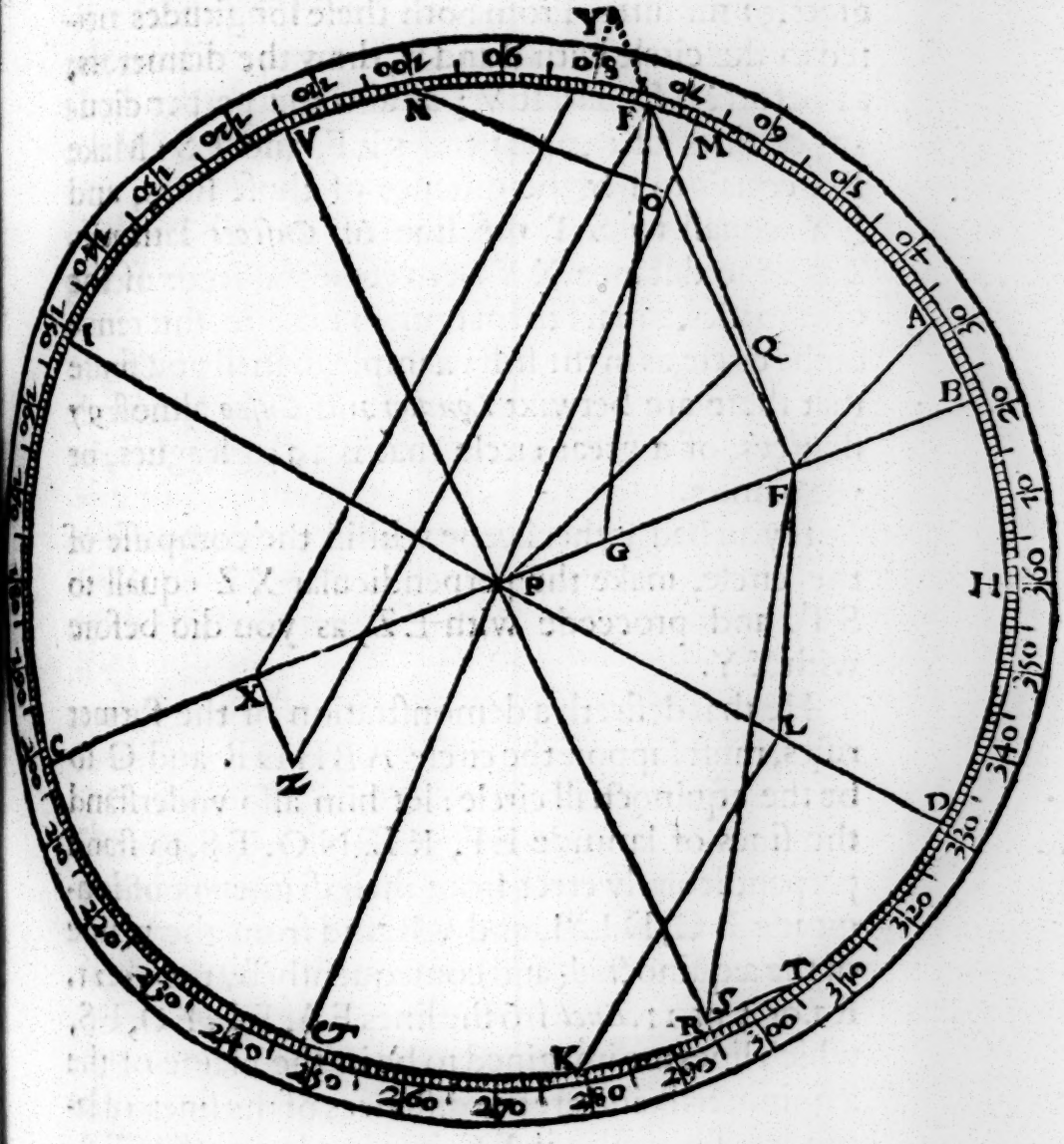
be both of one denomination, take with the compasses the length of ẏ perpendicular or fine drawne from the point of the leſſer latitude: and ſetting one foote in the point of the greater latitude, with the other make a prick in the perpendicular deſcen-

ding from it, that is, in the ſine thereof: Take the diſtance of this pricke from the former, made in the diameter: This diſtance transferred into the circle (as in the firſt example) will giue you the diſtance of the places giuen.

As *London* and *Hieruſalem* haue both Northerly and vnequall latitudes, *Hieruſalems* latitude being onely 32 degrees. Firſt therefore note in the circle both their longitudes: the longitude of *London* (*viz.* 22 degrees) as before with B: The longitude of *Hieruſalem* (68 degrees) note with M: Let the perpendicular or the ſines of the latitudes of *London* and *Hieruſalem*, E F, and N O be drawne as in the former examples. Make F P equall to O F, and P Q equall to N O: The ſpace betwixt P and Q taken with the compaſſes, and then both feete ſet in the circle (in ſuch ſort as in the firſt example was ſhewed) ſhal conteine between them the deſired diſtance of *Hieruſalem* from *London*, 38 degrees, and about $\frac{1}{4}$, that is 775 leagues, which are 2325 miles.

But if the latitudes be of diuers denominations, (that is, one Northerly, and the other Southerly) continue foorth the perpendicular (that croſſeth the diameter, wherein the foreſaid prick was made) till it bee equall to both perpendiculars, that is, to the ſines of both latitudes. The diſtance of the end of this continued perpendicular from the pricke aforeſaid in the diameter, taken with the Compaſſes, and tranſlated into the graduated peripherie of the circle (as before) will ſhew you how many degrees of a great circle are conteined betweene both places.

To



To shut vp this matter with one example, suppose you would know how farre *Cusco* in *Peru* is from *London*. Let the longitude of *Cusco* be 295 degrees, the latitude 11 degrees Southerly: The longitude of *London*, as before, 22 deg. the latitude 51 degrees,

grees,32 minutes. From both these longitudes noted in the circle with B and R, draw the diameters, as before, B C, and R V: as also the perpendiculars or sines of their latitudes E F, and T S: Make F X equall to F S, the distance of those sines, and E Y equall to S T the sine of *Cuscoes* latitude. Take the distance X Y betweene the feete of the Compasses, and set them both in the circumference of the circle, as in the first example, so shall you finde that there are betwixt *London* and *Cusco* almost 97 degrees, of a great circle that is 1940 leagues, or 5820 miles.

If you had rather keepe within the compasse of the circle, make the perpendicular X Z equall to S T, and proceede with E Z, as you did before with X Y.

He that desireth a demonstration of the former rules, must suppose the circle A B H D R and C to be the equinoctiall circle: let him also vnderstand the sines of latitude E F, K L, N O, T S, to stand perpendicularly erect from their diameters of longitude B C, D I, M, and V R, and from the plaine of the æquinoctial; and consequently by the 3 e. 11. Ra. or 4. pr. 11. *Eucl.* frō the lines F A, F L, F O, F S, which lines are imagined to be in the plaine of the æquinoctiall, and are the distances of the sines of latitude. Therefore if F G bee made equall to F A, (which is a line drawne in the plaine of the æquinoctiall from S. *Thomas* Iland to the sine of *Londons* latitude) E G must needs be equall to the line subtending the distance of *London* and S. *Thomas* Iland by the 2. e. 7. Ra. 4. 26. pr. 1. *Eucl.*

Also,

Alſo, becauſe all the ſines of latitude (being perpendicular to the ſame plaine of the æquinoctiall) are parallels, by the 5. e 21. *Ram.* 6. pr. 11. *Eucl.* Therfore by the 11. e 2. *Ram.* or 35. d. 1. *Eucl.* F L is the line ſubtending the diſtance of London and Cape Blanco.

Againe, becauſe F P whereto E F is perpendicular is made equall to F O, (the diſtance of the ſines of London and Hieruſalem, to which (diſtance) E F is alſo perpendicular in the Globe) and E Q alſo equall to N O: Therefore F Q being the difference of the ſines of Londons and Hieruſalems latitudes, there muſt needes be the ſame diſtance betwixt P and Q that there is betweene the tops of the ſines of Hieruſalems and Londons latitudes in the Globe.

Laſtly, F X being equall to F S (the diſtance of the ſines of latitude of London and Cuſco in Peru) and X Z perpendicular to F X, and æquall to S T the ſine of Cuſcoes latitude: as E F is the ſine of Londons latitude and perpendicular to the ſame line X F: E Z (to which X Y is equall by the 6. c. 12. e 5 *Ram.* 33. pr. 1. *Eucl.* Y E being equall and parallel to X Z) muſt needes bee equall to a ſtreight line extended within the Globe betweene the points of latitude of Cuſco and London.

Now out of this demonſtration it were an eaſie matter (if any liſt take the paines to bee ſo curious) to finde out the diſtance of any two places arithmetically by the doctrine of triangles, hauing alwaies two ſides giuen which are the ſines of the complements of the latitudes of the two places, as O P,

grees, 32 minutes. From both theſe longitudes no-

IRREGU
PAGINA

dons latitude) E G muſt needs be equall to the line ſubtending the diſtance of *London* and S. *Thomas* Iland by the 2. e. 7. Ra. 4. 26. pr. 1. *Eucl.*

Alſo,

Alſo, becauſe all the ſines of latitude (being perpendicular to the ſame plaine of the æquinoctiall)

tically by the doctrine of triangles, hauing alwaies two ſides giuen which are the ſines of the complements of the latitudes of the two places, as OP, FP:

grees,32 minutes. From both these longitudes noted in the circle with B and R, draw the diameters, as before, B C, and R V: as also the perpendiculars or sines of their latitudes E F, and T S: Make F X equall to F S, the distance of those sines, and E Y equall to S T the sine of *Cuscoes* latitude. Take the distance X Y betweene the feete of the Compasses, and set them both in the circumference of the circle, as in the first example, so shall you finde that there are betwixt *London* and *Cusco* almost 97 degrees, of a great circle that is 1940 leagues, or 5820 miles.

If you had rather keepe within the compasse of the circle, make the perpendicular X Z equall to S T, and proceede with E Z, as you did before with X Y.

He that desireth a demonstration of the former rules, must suppose the circle A B H D R and C to be the equinoctiall circle: let him also vnderstand the sines of latitude E F, K L, N O, T S, to stand perpendicularly erect from their diameters of longitude B C, D I, M, and V R, and from the plaine of the æquinoctial; and consequently by the 3 e. 21. Ra. or 4. pr. 11. *Eucl.* frō the lines F A, F L, F O, F S, which lines are imagined to be in the plaine of the æquinoctiall, and are the distances of the sines of latitude. Therefore if F G bee made equall to F A, (which is a line drawne in the plaine of the æquinoctiall from S. *Thomas* Iland to the sine of *Londons* latitude) E G must needs be equall to the line subtending the distance of *London* and S. *Thomas* Iland by the 2. e. 7. Ra. 4. 26. pr. 1. *Eucl.*

Also,

Alſo, becauſe all the ſines of latitude (being perpendicular to the ſame plaine of the æquinoctiall) are parallels, by the 5. e 21. *Ram.* 6. pr. 11. *Eucl.* Therfore by the 11. e 2. *Ram.* or 35. d. 1. *Eucl.* F L is the line ſubtending the diſtance of London and Cape Blanco.

Againe, becauſe F P whereto E F is perpendicular is made equall to F O, (the diſtance of the ſines of London and Hieruſalem, to which (diſtance) E F is alſo perpendicular in the Globe) and E Q alſo equall to N O: Therefore F Q being the difference of the ſines of Londons and Hieruſalems latitudes, there muſt needes be the ſame diſtance betwixt P and Q that there is betweene the tops of the ſines of Hieruſalems and Londons latitudes in the Globe.

Laſtly, F X being equall to F S (the diſtance of the ſines of latitude of London and Cuſco in Peru) and X Z perpendicular to F X, and æquall to S T the ſine of Cuſcoes latitude: as E F is the ſine of Londons latitude and perpendicular to the ſame line X F: E Z (to which X Y is equall by the *6.* c. 12. e 5 *Ram.* 33. pr. 1. *Eucl.* Y E being equall and parallel to X Z) muſt needes bee equall to a ſtreight line extended within the Globe betweene the points of latitude of Cuſco and London.

Now out of this demonſtration it were an eaſie matter (if any liſt take the paines to bee ſo curious) to finde out the diſtance of any two places arithmetically by the doctrine of triangles, hauing alwaies two ſides giuen which are the ſines of the complements of the latitudes of the two places, as O P, F P:

FP: LP, FP: RP, FP: AP, FP: together with the angle conteined betweene them, that is the difference of their longitudes: whereby FA: FO: FL: FS, the distances of the sines of latitude being found by the 2, 3, 4, 5, *Copernic. de Triang. planis*, the lines also subtending the distances of the places may most easily be found by the 3. *Copernic. de Triang. plan.* For the squares of the distance of the sines, and of the difference of the sines of their latitudes (if both be Northerly or both Southerly) or of the summe of the sines of their latitudes (if one bee Northerly, another Southerly) are equall to the square of the line subtending the distance of the places 5. e 12. *Ram.* 47. pr. 1. *Eucl.*

With no lesse facilitie also by helpe of the former Tables, and the Canon of Triangles, any two places being giuen, there may arithmetically and most exactly be found out, first, by their longitudes and latitudes, the rumb, and distance measured in the rumbe: secondly, by their distance, and latitudes, the rumbe and difference of longitude: thirdly, by their rumbe, and latitudes, the distance and difference of longitude: fourthly, by their longitudes, rumbe, and one latitude, the other latitude and distance: fiftly, by the rumbe distance and one latitude, the other latitude, and the difference of longitude; or any other nauticall or geographicall probleme that by the Chart may mechanically be performed: and the whole Art of Nauigation Arithmeticall (as some call it) may as easily bee practised: So as, hauing onely the longitudes and latitudes of the places (by which, and to which you

are

are to ſaile) ſet down in a Table, you may by Arithmeticall calculation only (if you liſt take the paines) without any Chart, Mappe, or Globe, ſhew the courſe and diſtance from any place to other: and ſo giue moſt exact direction for the performance of an whole voiage to any knowne place aſſigned, how oft ſoeuer you haue trauerſed or been toſſed this way, and that way, by reaſon of ſcant, violent, or contrarie winds, or any other occaſion.

But ſeeing the firſt grounds of this Art, that is, the obſeruations of the latitudes, but eſpecially of the courſes at Sea, cannot but bee farre from ſuch exquiſite truth as is to be found in thoſe Arithmeticall operations: how exact ſoeuer you bee in the reſt of the meanes, you can looke for no more truth in concluſion then ſuch as is anſwerable to the firſt grounds and principles, out of which the concluſion is gathered. So as the Mariner ſhall not neede to trouble himſelfe any further herewith, but only to caſt vp his accounts vpon the Chart trulie made (as before is ſhewed) which of all other is moſt fit and readie for his ordinarie vſe. Now therefore it may bee ſufficient, onely to ſhew how the former Problemes may mechanically be performed vpon the nauticall planiſphære before deſcribed.

1. By the longitudes and latitudes of two places, to find the rumb and diſtance.

Firſt, by the longitudes and latitudes of both places giuen, the rumbe and diſtance may thus be found: Draw parallels by both latitudes: take the diſtance of thoſe parallels: according to which diſtance draw a parallel to the æquinoctiall. Then from the end of the difference of longitude, reckoned from the concurſe of the rumbes in the æquinoctial,

noctial, erect a perpendicular crossing the said parallel: A line drawne by this crossing from the concurse of the rumbes is the rumbe of the two places. Now to finde out the distance, take so many degrees of the æquinoctial as the difference of latitude conteineth: and guiding one foote of the compasses in the æquinoctial, with the other foote carried parallel-wise at equall distance from the æquinoctial, crosse the rumbe newly found out: take the distance of this crossing from the concurse of the rumbes, and set both feete of the Compasses in the æquinoctiall, for the degrees conteined betweene them shew you the distance desired.

2. By the distance and latitudes, to find the rumbe and difference of longitude.

Secondly, by the distance and latitudes (knowing which place is more Eastwards, or Westwards) the rumbe and difference of longitude is thus found: Take with the compasses so many degrees and minutes of the æquinoctial, as the difference of latitude conteineth: According to that distance draw a parallel to the æquinoctial; take so many degrees of the æquinoctial with your Compasses as the distance giuen commeth to: then one foote being set in the concurse of the rumbes in the æquinoctiall, with the other crosse the parallel aforesaid: A line drawne by that crossing from the concurse of the rumbes in the æquinoctiall giueth you the rumbe desired. Then both latitudes being noted in the graduated meridian, therein take their difference with the compasses, and guiding one foote in the æquinoctiall, with the other carried at that distance parallel-wise from the æquinoctiall, crosse the rumbe of the two places: the distance of that

crossing

croſſing from the meridian (that commeth from the common meeting of the rumbes in the æquinoctiall) taken with the compaſſes, and brought to the æquinoctiall, ſhall there ſhew you the difference of longitude. Or a perpendicular to the æquinoctiall from that croſſing ſhall point you out therein, the difference of longitude.

3. By the rumb and latitudes to finde the diſtance and difference of longitude.

Thirdly, by the rumbe and latitudes (being both Northerly or both Southerly) the diſtance and difference of longitude is thus found: Take the difference of latitudes in the æquinoctiall: according to that diſtance draw a parallel to the æquinoctiall (as before) croſſing the rumb of the two places giuen: take the diſtance of this croſſing from the concurſe of the rumbes: Then both feete of the compaſſes ſet in the æquinoctiall will ſhew the diſtance of the places. The difference of longitude is found as before.

4. By the longitudes, rumb, and one latitude, to finde the other latitude and the diſtance.

Fourthly, by the longitudes, rumbe, and one latitude (knowing whether it bee the leſſer or greater) to finde the other latitude, and the diſtance, doe thus: From the point of concurſe of the rumbes in the æquinoctiall count the difference of longitude: from hence erect a perpendicular croſſing the rumbe: the diſtance of this croſſing from the æquinoctiall tranſlated into the graduated meridian (ſetting one foote in the knowne latitude, and extending the other Northwards or Southwards according as the vnknowne latitude is greater or leſſer) ſhall ſhew you the latitude deſired. Now to finde the diſtance, worke as before in the firſt Probleme.

Fiftly,

5. By the rũbe, the diſtance, and one latitude, to finde the other latitude and the difference of longitude.

Fiftly, by the rumbe, diſtance, and one latitude, you may finde the other latitude and the difference of longitude after this manner: Take the diſtance giuen with the Compaſſes in the æquinoctiall: ſet one foote in the concurſe of the rumbes, and with the other croſſe the rumbe giuen: from this croſſing draw a perpendicular to the æquinoctiall: the length of that perpendicular taken with the Compaſſes and brought into the æquinoctial, ſhall ſhew you the difference of latitude. Thus hauing both latitudes giuen, the difference of longitude may alſo be found as before, Prob. 2.

Now in euery one of theſe problemes there may be ſome particular caſes whereof ſome diuerſitie of working may ariſe, yet ſuch as can breed but ſmall trouble to him that well doth conceiue the reaſon of that is alreadie ſet downe in theſe fiue former Problemes: which are eſpecially to bee applied to ſuch places as are both on ỹ ſame ſide of the æquinoctial, and differ alſo both in longitude and latitude: of which ſort is the greateſt number, and in which the greateſt vſe, and moſt difficultie of working conſiſteth. To proſecute euery particularitie at large (whereof ſome perhaps leſſe acquainted with the reaſon of theſe Mathematicall practiſes may be deſirous) would bee now for mee too long and tedious. For ſome taſte therefore of the vſe of this nauticall planiſphære, let thus much for this time briefly ſuffice.

CHAP.

Chap. XIII.

Error in the vſe of the Compaſſe, by the variation neglected, and how to obſerue and auoid the ſame.

NExt the Sea-chart there is not any inſtrument of Nauigation whereby greater error may enſue then by the Compaſſe, if the variation bee neglected. By which neglect alone wee may often times miſſe an whole point and more, in directing the courſe from place to place. Notwithſtanding, M. *Peter* of *Medina* laboureth greatly to proue that there is no variation of the Compaſſe, and that many inconueniences and abſurdities muſt needes follow out of that opinion (as hee eſteemeth it) thinking it to haue no better ground then the groſſe and erroneous obſeruations of vnskilfull Mariners, as by the third Chapter of his ſixt booke of the Art of Nauigation may appeare more at large. But daily experience (by many and diligent obſeruations, with exact inſtruments, heedfully vſed by skilfull obſeruers, not only at ſea, the vnconſtancie whereof (which cauſeth the ſhip to be alwaies vnſteadie) might giue ſome colour to M. *Peters* conceit of no variation: but alſo on firme land, where moſt ſteadie and certaine obſeruation may eaſily be made:) I ſay daily experience hath ſo often, ſo conſtantly, ſo manifeſtly proued this varying propertie to be in the Compaſſe, that it cannot by any meanes with reaſon be denied.

Now then for the better finding of this variation there muſt be conceiued two meridians; a true median

ridian, and a magneticall meridian: alſo a true azimuth, and a magneticall azimuth of the Sunne.

The true meridian is an azimuth paſſing by the poles of the world.

The magneticall meridian is an azimuth that paſſeth by the points of the wires in the compaſſe, or of the needle touched with the loadſtone.

The true azimuth of the Sunne is ſhewed by the arch of the horizon contained betwixt the azimuth of the Sunne, and the true meridian.

The magneticall azimuth of the Sunne is ſhewed by the arch of the horizon contained betweene the magneticall meridian & the azimuth of the Sun.

The difference of theſe two arks of the horizon is alwaies equall to the variation of the Compaſſe.

To find out the magnetical azimuth of the Sun, we muſt firſt know vpon what point of the Compaſſe the Sun is: which although it may be done by aime very neere the truth by him that is experiēced, eſpecially when the Sun is low, or at the horizon, riſing or ſetting: yet it may better be done with helpe of ſuch a ruler and ſights, as land-meaſurers vſe with their plaine tables, wherewith you may thus finde vpon what point of the Compaſſe the Sun is: Lay the edge of the ruler right ouer the center of the Compaſſe: then holding the ruler ſo fixed, and the Compaſſe leuell ſo neere as you can aime, turne it about vntill the midſt of the Sun-beames paſſing through one of the ſights, fall alongſt vpon the edge of the ruler, or midſt of the oppoſite ſight. Then holding your eye in ſuch ſort ouer the Compaſſe, that the rulers edge may lie right vpon the center of the

flie,

stie, looke also vpon what point of the compasse the edge of the ruler lieth to the Sun-wards, for that is the point whereupon the Sun is at that time: which for breuities sake may be called the Sunnes point. This point you shall look in the instrument following, and it shall shew you amongst the degrees the magneticall azimuth of the Sun. As for example, when the Sun is due East by the compasse, I would know in what magneticall azimuth he is: Therfore I look the East point in this Instrument, which directeth me to 84 degr. $\frac{1}{8}$, which is the magneticall azimuth desired. And the difference betwixt this and the true azimuth of the Sun is the variation of the compasse which we seek for. This difference therefore shall thus be found out: At the same time whe you obserue the Sunnes point, let the height of the Sun be also obserued. It is best to take both these obseruations about the midst of the forenoone, or afternoone, for then the height of the Sunne altereth quickly, and the refraction and parallax cannot much deceiue you, therefore at that time the true azimuth of the Sunne shall easily be knowne thus: First finde out the declination of the Sun, remembring alwaies to giue allowance, or take away (according as the declination increaseth or decreaseth) for the place and time of your obseruation: Then set your Astrolabe to the latitude of the place where you obserue, and follow the parallel of the Suns declination, vntill you come to the almicantarath or height of the Sun knowne by obseruation: for the azimuth that passeth by their mutuall intersection, is the true azimuth of the Sunne that was sought for:

which

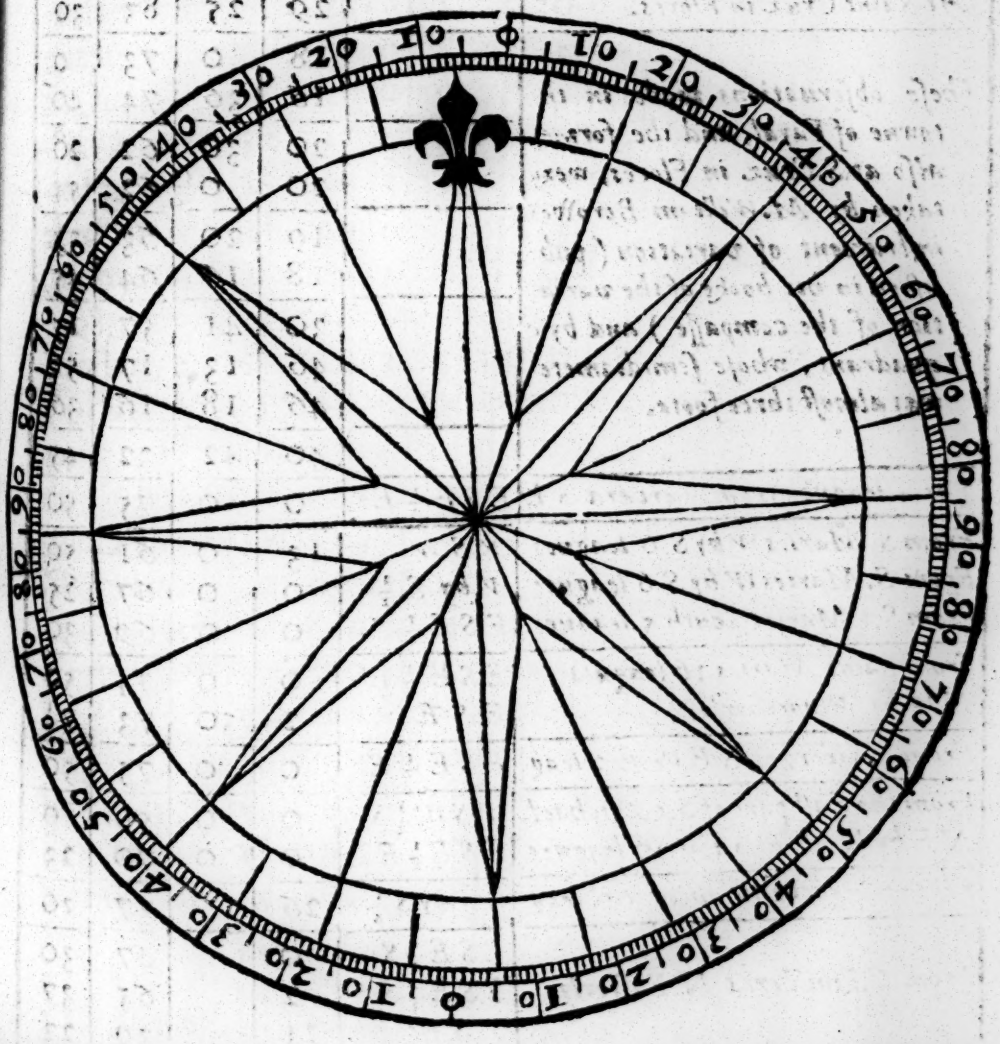
which if you follow down to the horizon, you ſhall haue that azimuth giuen. Now of theſe two giuen azimuths (that is, the true and magnetical azimuth of the Sun) ſubtract the leſſer from the greater, for the difference remaining is the variatiō of the compaſſe: the denomination whereof (that is, whether it be Eaſterly or Weſterly) ſhall eaſily be diſcerned thus: If the true azimuth of the Sun counted from the South point in the forenoone, be leſſe then the magneticall azimuth, the variation is Eaſterly: otherwiſe it is Weſterly. Contrariwiſe, in the afternoone: if the true azimuth of the Sunne be greater then the magneticall azimuth, the variation of the Compaſſe from the point of true North is Eaſtwards, otherwiſe it is Weſtwards. And for the better vnderſtanding of theſe rules, I haue in the table following exemplified them by ſuch obſeruations, as I tooke both at Sea and land, in the yeere 1589.

The inſtrument following is then to be vſed whē obſeruation is made, as before hath bin ſhewed, by a Compaſſe, wherein the North points of the wires are ſet half a point to the Eaſtwards from the North point of the Compaſſe (of which ſort are the Compaſſes that are commonly vſed by Engliſh mariners) whereas if the points of the wires were ſet iuſt vnder the points of North and South: and the circumference of the Compaſſe diuided into degrees both Eaſtwards and Weſtwards, beginning at the North and South points, and ending with 90 at Eaſt and Weſt: wee might at the firſt haue the magneticall azimuth of the Sunne by obſeruation, and ſo there ſhould be no need of this inſtrument.

In

In the table here following the letters N, W, S, E, b, in the first & second columnes, signifie North, West, South, East, by. The fractions in the second columne are parts of the point whereto they are annexed. In the columne intituled, The time of observation, the letters B N, and A N signifie, before noone, and after noone.

An Instrument for the readie finding of the Suns magneticall Azimuth by the ordinary Compasse.



The place of obseruation.	The Sunnes point of the Compasse.	The height of the Sunne		The Sunnes magnetical azimuth.	
		Deg.	Min.	Deg.	Min.
About twenty leag. from Spaine W or 40 leagues from Spaine W	W NW $\frac{1}{2}$ N	0	0	69	30
	E NE $\frac{1}{2}$ E	0	0	56	15
About the midway betwixt Lisbon and Saint Michaels.	E NE	0	0	61	40
	W NW	0	0	73	7
Betwixt S. Michaels and Tercera.	E by N	2	0	70	52
About 3 leag. from Tercera S	E by N $\frac{1}{2}$ N	2	30	70	53
At Saint Cruz in Flores.		29	25	83	30
These obseruations made in the towne of Payal, and the former also at S. Cruz in Flores, were taken by M. William Borowes instrument of variation (published in his booke of the variation of the compasse) and by a Quadrant, whose semidiameter was almost three foote.		18	0	73	0
		16	36	74	40
		20	30	62	20
		20	0	62	54
		19	20	53	35
		18	16	64	45
		30	41	57	15
		46	13	17	53
		46	18	16	36
		40	42	32	45
4 or 4 leagues from Tercera S E	E S E $\frac{1}{4}$ E	0	0	75	50
From S. Maries W by S 6 leagues	W S W	13	0	61	50
From S. Maries W by S 6 leagues	W by S $\frac{1}{2}$	0	0	67	25
From S. Maries South 5 leagues	E S E $\frac{1}{2}$ S	0	0	69	30
From Saint Maries 16 leagues NW by W northerly.	E S E $\frac{1}{4}$ E	0	0	75	50
	E S E	2	20	73	7 $\frac{1}{2}$
From S. George S E by E 3 leag.	E S E $\frac{1}{2}$ E	0	0	75	50
From the East part of S. Michael NE by N. about 15 or 20 leagues	W S W $\frac{1}{4}$ S	0	0	59	0
	E S E $\frac{1}{2}$ E	0	0	70	23
From the rocke W about 66 leag	S by S $\frac{1}{4}$ S	26		37	30
From C. Finisterra N Easterly	E S E $\frac{1}{2}$ S	0		67	30
	E S E $\frac{2}{3}$ S	2		65	37
	S W	11		29	22

The time of observation.		The latitude of the place observ.		The declination of the Sunne.		The true azimuth of Sunne.		The variation of the Compasse.		The middle variation.		The part of variation.
		De.	Mi.	De.	Mi.	De.	Mi.	De.	Mi.	Deg.	Min.	
Iul. 9	A N	39	50	20	53	62	0	7	30			Eastward
12	B N	39	0	20	25	63	20	6	45			Eastward
23	B N	38	0	17	55	67	0	5	20	5	38	Eastward
23	A N	38	0	17	46	67	10	5	57			Eastward
Aug. 8	B N	38	20	13	13	74	10	3	18			Eastward
9	B N	38	20	12	54	75	0	4	7			Eastward
14	A N	39	50	11	5	79	30	4	0			Westward
Se. 13	A N	38	54	0	8	74	35	1	35			Eastward
13	A N	38	54	0	9	76	0	1	20			Eastward
22	A N	38	54	3	39	67	10	4	50			Eastward
22	A N	38	54	3	39	67	30	4	36			Eastward
22	A N	38	54	3	30	68	15	4	40	3	5	Eastward
22	A N	38	54	3	40	69	20	4	35			Eastward
23	B N	38	54	3	53	54	20	2	55			Eastward
23	B N	38	54	3	54	14	0	3	53			Eastward
22	B N	38	54	3	54	13	30	3	6			Eastward
23	A N	38	54	4	0	35	15	2	30			Eastward
Oc. 18	B N	38	20	13	5	73	0	2	5			Eastward
23	A N	37	0	14	50	60	0	1	50			Westward
23	A N	37	0	14	51	71	5	3	40	0	55	Eastward
24	B N	37	0	15	2	70	50	3	20			Westward
26	B N	37	30	15	38	69	50	6	0	5	34	Eastward
26	B N	37	30	15	39	68	0	5	7			Eastward
28	B N	38	40	16	16	68	45	7	5			Eastward
No. 1	A N	38	40	17	30	67	10	8	10			Eastward
2	B N	38	40	17	41	66	50	3	33			Eastward
6	B N	38	35	18	43	31	0	6	30			Eastward
12	B N	44	25	20	5	61	0	6	30	7	4	Eastward
12	B N	44	25	20	5	58	0	7	37			Eastward
12	A N	44	30	20	11	46	15	6	52			Eastward

Notwithſtanding there bee much difference betwixt ſome of theſe variations takē at the ſame place with the ſame inſtruments, yet wee vſed with what diligence wee could ſuch inſtruments as then wee had prepared for that purpoſe: which I ſpeake, that others that ſhall goe about hereafter to obſerue the variation (at ſea eſpecially) may be the more circumſpect to foreſee and preuent all cauſes of error herein. Exact truth amongſt the vnconſtant waues of the ſea is not to bee looked for, though good inſtruments be neuer ſo well applied to their vſe. Yet with heedfull diligence we may come ſo neere the truth, as the nature of the ſea and of our ſight and inſtruments will giue vs leaue. Neither if there bee ſome diſagreement betwixt obſeruations, are they all by and by to be reiected. But as when many arrowes are ſhot at a marke, and the marke afterwards taken away, he may be thought to worke according to reaſon, who to finde the place where the marke ſtood, ſhall ſeeke out the middle place amongſt all the arrowes: ſo amongſt many different obſeruations, the middlemoſt is likeſt to come neereſt the truth.

Cauſes of error herein, ſome cannot be auoided, as the vnſteadineſſe of the ſhip, the imperfection of ſenſe and inſtruments, the weake reſpectiue force of the needle or wires, be they neuer ſo well touched. Others may be eſchued, as that there bee no iron neere the Compaſſe in time of obſeruation, that the wires be kept cleane from ruſt, and that they be not kept too long vntouched from the ſtone, that ſuch inſtruments be vſed for obſeruation as need leaſt working afterwards for finding out the variation:

tion: wherein the inſtruments heretofore publiſhed for this purpoſe, are faultie, being ſuch as ſerue for obſeruation onely on land: as alſo requiring many workings afterwards, vnfit for Mariners, before the matter can come to iſſue, wherein are as many lurking holes of error without great diligence. I haue therefore heere ſet downe the making and vſe of a certaine inſtrument, whereby the variation of the Compaſſe and time of the day is preſently giuen, together with the obſeruation (the latitude of the place being knowne) and ẏ vniuerſally throughout the world, both at ſea and land. As alſo the variation being giuen, the height of the pole, and houre of the day may thereby be knowne, without thoſe inconueniences, wherewith *Martin Corteſe* his inſtrument, Chap. 11. part 3. of the Art of Nauigation, and *Michael Coignet* his nautical hemiſphere, are much incumbred: to omit the obſeruation of the height of the Sunne, which (as I haue oft made triall at ſea) may thereby bee more exactly performed, then hath been hitherto by ſtaffe, ring, or aſtrolabe, as they are commonly vſed.

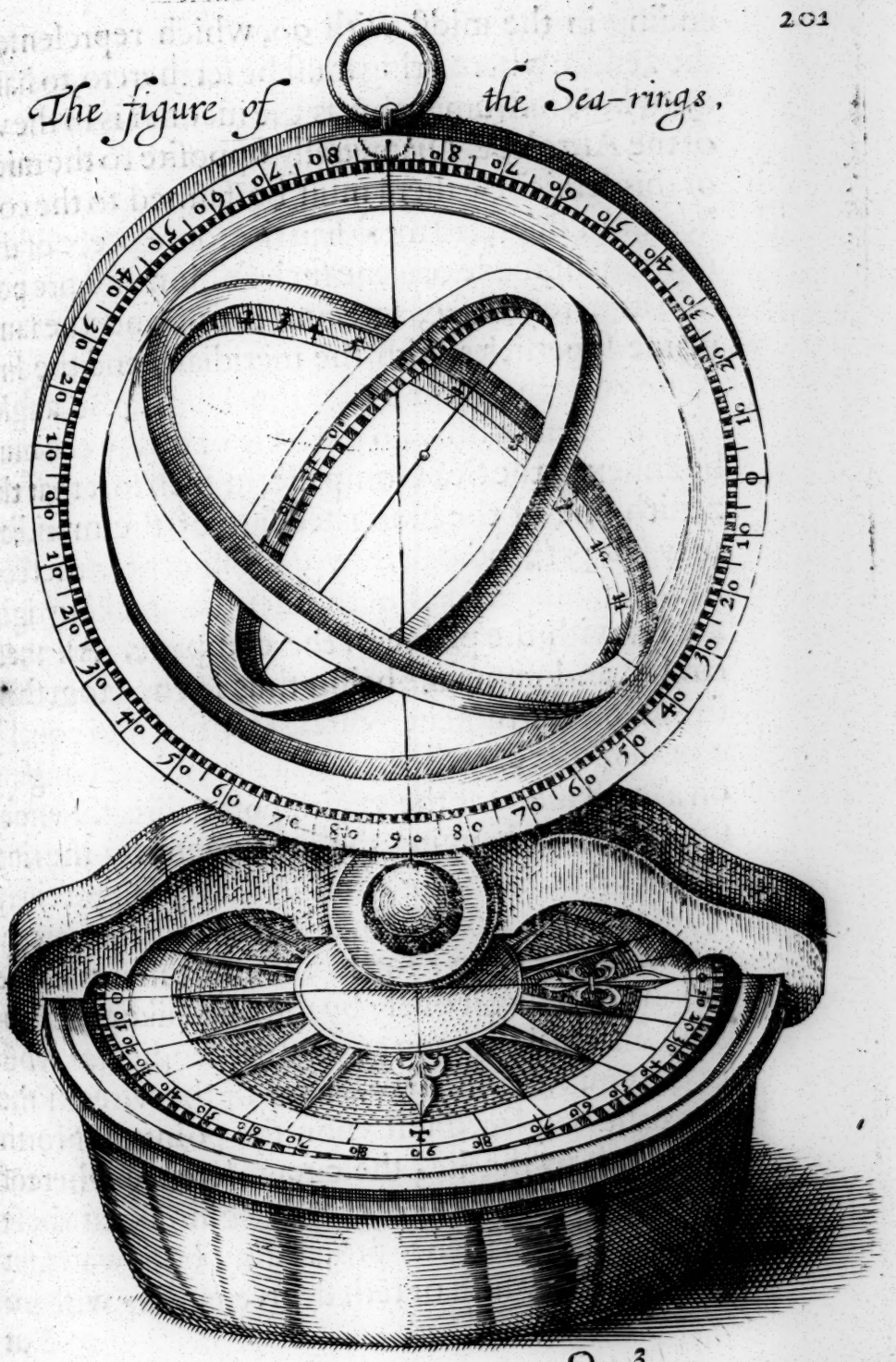
The making of the Sea-rings.

MAke foure rings of equal thicknes and breadth conuenient, ſo as they may not eaſily bend: let them be fitted that each of them may goe cloſe within other. The two greateſt of theſe rings muſt be ſo made and framed together, that the innermoſt may ſlide about within the vttermoſt, both ſides agreeing alwaies, euen together in one and the ſame plaine ſuperficies. Within the innermoſt of theſe

two rings muſt the third ring be hanged vpon two round pins diametrally oppoſite each to other; ſo as vpon thē it may be turned aſide, till it make right angles with the former. Againe, within this third ring muſt the fourth be hanged likewiſe vpon two pins diametrally oppoſite 90 degr. diſtant from the former pins. The vppermoſt ring repreſenteth the meridian fixed: the next within it repreſenteth a meridian moueable: the third ſignifieth the æquinoctial or parallel of the Sun: the fourth, the circle paſſing by the points of Eaſt and Weſt, and by the poles of the world. Vpon one of the ſides of the innermoſt and moueable meridian (90 degrees from the pins whereupon the æquinoctiall ring hangeth) muſt be fixed an index or pointer, the point whereof may reach vnto the midſt of the conuexitie of the innermoſt circle, into a little hole, diſtant from the middle point betweene the pinnes or poles whereupon it hangeth, ſo much as halfe the thicknes of that circle commeth to, ſo as the point of that index being put into this hole, the meridian and the inner circles may croſſe each other preciſely at right angles. Nintie degrees from the pinnes or poles of this innermoſt ring, through the midſt of the concauitie and conuexitie thereof, muſt two ſmall holes be made; and a threed ſtretched ſtraight betwixt them (repreſenting the axtree of the world) with a ſmall beade (about the bigneſſe of a pinnes head) put here vpon, repreſenting the center of the earth. Let the vpper halfe of the vppermoſt and fixed meridian be diuided into 180 degrees, ſetting figures to euery tenth or fifth degree, beginning at either end, and

ending

The figure of the Sea-rings.



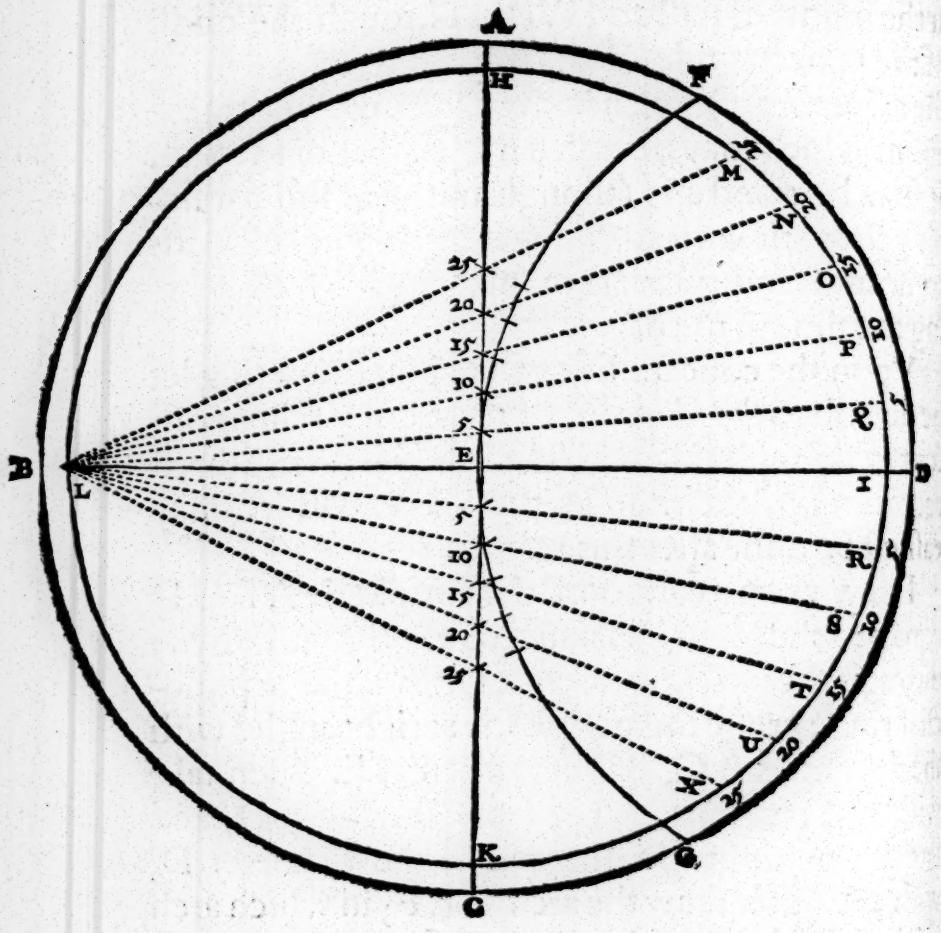
ending in the midſt with 90, which repreſenteth the zenith: where a ring muſt be ſet thereto, to hang the whole inſtrument by, as the manner is in the vſe of the Aſtrolabe. Diametrally oppoſite to the midſt of this ſemicircle there muſt be faſtned to the conuexitie of this fixed meridian the foote peece of this inſtrument, made of ſome ſuch faſhion and proportion as here you ſee, agreeing in one and the ſame plaine ſuperficies with the meridian, and the line paſſing by the feete thereof making right angles with the zenith line. To the feete of this peece muſt be annexed the Sea Compaſſe, in ſuch ſort that the zenith line of the graduated ſide of the meridian may fall perpendicularly vpon the center thereof, the plaine ſuperficies of the meridian making right angles with the plaine of the compaſſe. All theſe circles, and compaſſe being thus ioyned together, the whole inſtrument muſt be rectified and equally counterpoized by the help of a plumbline hanging on a ſmall pinne at the zenith point directly vnder the ring, that hanging the inſtrument by the ring (like an Aſtrolabe) the plumbline may fall preciſely vpon the nadir point of the fixed meridian, ſcarcely touching the ſame: for ſo the inſtruments owne weight, hanging it onely by the ring (like an Aſtrolabe) ſhall make it hang exactly perpendicular, whē-ſoeuer you vſe it. Let the points of the wires in the compaſſe be placed iuſt vpon the points of North and South in the flie; the circumference whereof muſt be diuided into degrees, beginning at thoſe points, and from thence proceeding both waies, ſet figures at euery fifth or tēth degree, ending with 90

at

at the points of Eaſt and Weſt. Through the midſt of the concaue ſide of the third ring (repreſenting the æquinoctial) muſt a periphery be drawne round about, which may be called the parallel of the Sun. It ſhall be good alſo (though not needfull for finding the variation) to diuide it into 24 equall parts or houres, and quarters, or ſmaller parts, for knowing the time of the day.

Vpon the concaue ſide of the innermoſt ring let be deſcribed the degrees of the Suns declination, for the right placing of the little bead vpō the thred according to the time of the yeere. Which may eaſlieſt be done after this manner:

Draw vpon a paſtboord the peripherie A B C D equall to the forcſaid parallel of the Sunne drawne through the midſt of the concauitie of the æquinoctial ring: croſſe this peripherie at right angles with the diameters A C, B D at the center E. Then take with your compaſſes the ſemidiameter E D, and ſetting one foote in the end of the diameter D, with the other draw the arch G E F; in which arch pricke out both waies from E ſo many degrees, as the Sunnes greateſt declination amounteth vnto: and laying your ruler to D, and to euery one of thoſe degrees; croſſe the diameter A C with ſhort ſtrokes, as you ſee in this diagramme, and laying the ruler to euery one of thoſe croſſes and the pricke at B, make prickes by the ſide of the ruler in the innermoſt peripherie H I K L, which muſt be equall to the concauitie of the innermoſt ring of the inſtrument: And then laying the concauitie and quarters of that ring iuſtly agreeable with



this peripherie, and the ends of the diameters thereof (the thred vpon which the little beade rideth) lying right ouer the diameter H K, you may with a ſharpe point of ſteele ſtrike vp the ſaid pricks made in the innermoſt peripherie into the concauitie of the innermoſt ring, and to euery fifth or tenth degree ſet figures as the manner is. There muſt alſo be made in the ſaid innermoſt ring a point anſwerable to the point at B in this former figure, in which point there muſt bee faſtned a ſmall ſtump ſtanding vpright

vpright from the ſide of that ring about the height of a pinnes head. By meanes whereof and the degrees of the Sunnes declination (proiected, as wee haue ſhewed, into the concauitie of the innermoſt ring) the little beade muſt be right placed vpon the thred, by bringing it into a ſtraight line betweene that ſtump and the Sunnes declination antwerable to the time of your obſeruation: which may bee done by laying the edge of a ſtraight ruler, or a ſmall thred ſtretched from that ſtump, to the degree and part of the Sunnes declination, and then bringing the midſt of the bead vnder that edge or thred: Or elſe by ſight only, with one of your eyes, laying the top of that ſtump vpon the Sunnes declination, and then bringing the bead betweene; ſo as you may ſee them all three in one ſtraight line.

The bead being thus rightly placed, put aſide the æquinoctiall ring from the braſſe pointer (repreſenting the pole artick) that it may croſſe the meridian at right angles, which it ſhal preciſely do, if you bring the prick or little hole, vpō the outſide of the innermoſt circle to the end of the foreſaid braſſe pointer, ſo as the end thereof may enter thereinto. Then ſet the line that is drawne from the end of the braſſe pointer, to the eleuation of the pole at the place of your obſeruation, and ſo haue you all parts of your inſtrument rightly placed for obſeruation.

Now when you will make obſeruation with this inſtrument, hang the ſame by his ring vpon your finger, as you doe when you obſerue the height of the

The vſe of this inſtrument.

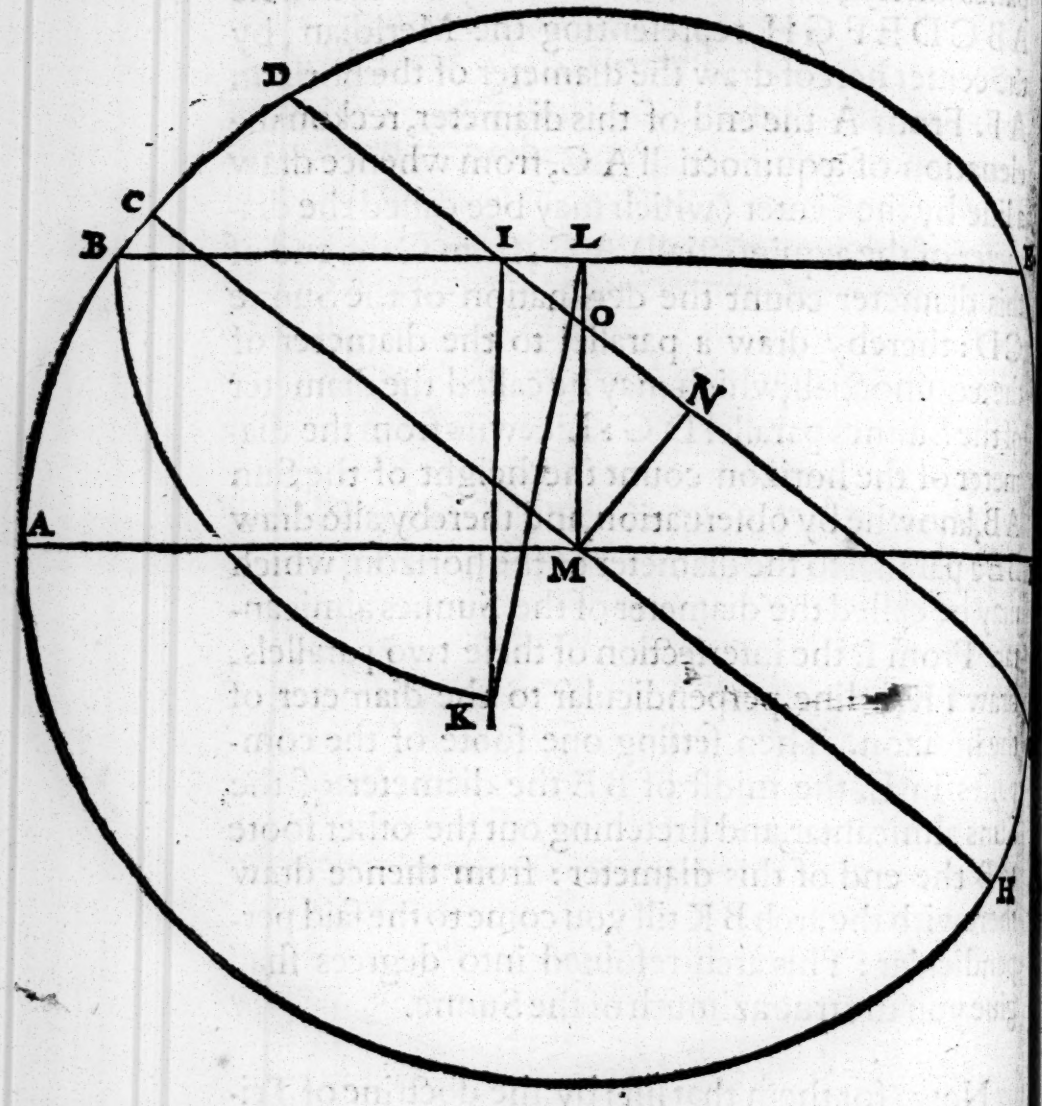
the Sunne with the Aſtrolabe; turning the foreſaid braſſe pointer Northwards, till you finde the midſt of the ſhadow of the beade to fall vpon the peripherie drawne round about through the midſt of the concauitie of the æquinoctiall ring, which peripherie wee called the parallel of the Sunne: and ſo keepe the whole inſtrument and compaſſe as ſteady as you can, till the flie of the compaſſe remaine quiet and ſtill; keeping in the meane time the midſt of the ſhadow of the beade alwaies vpon the foreſaid parallel of the Sunne; and withall looking cloſe by the graduated ſide of the meridian directly downe vpon the midſt of the Compaſſe, and marke what degree and minute you ſee cloſe thereby in the North part of the flie: for ſo much as the North point of the needle or wiers is from thence towards the Eaſt or Weſt, ſo much is the variation Eaſtwards or Weſtwards. And the ſhadow of the beade lighting vpon the parallel of the Sun ſheweth the houre and time of the day.

The beſt time for the taking of theſe obſeruations is about the midſt of the forenoone or afternoone, becauſe that about thoſe times the height of the Sunne altereth quickly, and his refraction alſo can breed no ſenſible error. But becauſe there be many that want both this inſtrument, & alſo the Globe and Aſtrolabe before mentioned, I haue for their ſakes thought it good to ſet downe a way whereby (the declination and height of the Sun being giuen, together with the latitude of the place) the Sunnes true azimuth may bee found with ruler and compaſſes

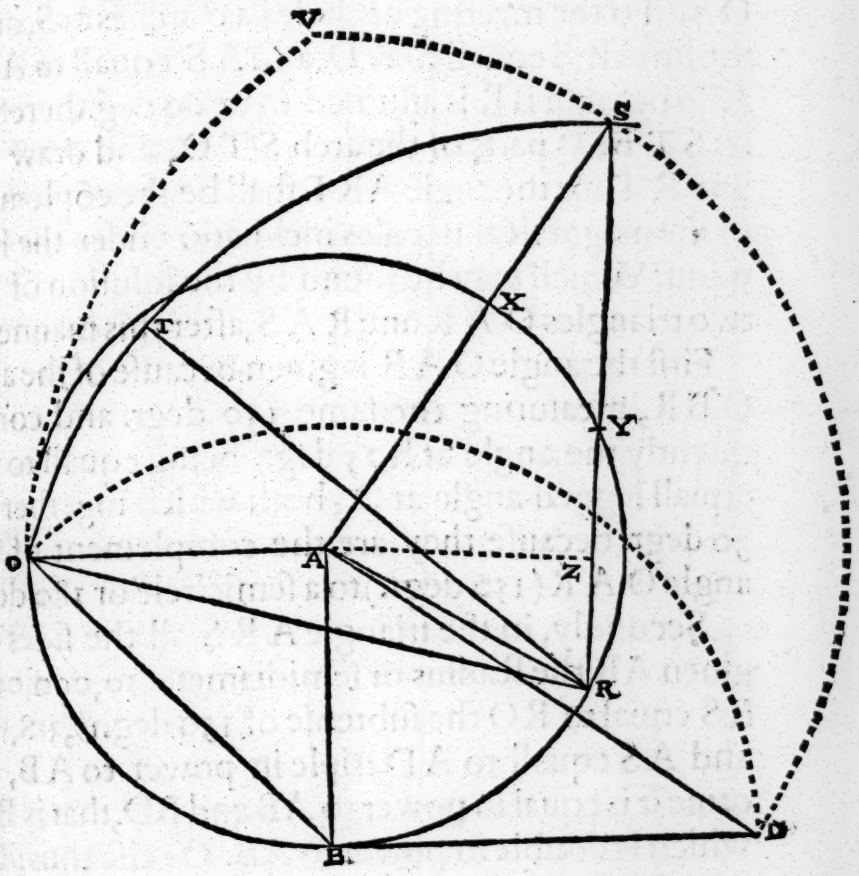
paſſes onely, after this manner: Draw the circle A B C D E F G H, repreſenting the Meridian, by the center hereof draw the diameter of the horizon A F. From A the end of this diameter, reckon the eleuation of æquinoctiall A C, from whence draw a line by the center (which may bee called the diameter of the æquinoctiall) A C; from C the end of this diameter count the declination of the Sunne C D: thereby draw a parallel to the diameter of the æquinoctiall, which may be called the diameter of the Sunnes parallel D G: Likewiſe from the diameter of the horizon count the height of the Sun A B, knowne by obſeruation, and thereby alſo draw B E a parallel to the diameter of the horizon, which may be called the diameter of the Sunnes almicantar. From I, the interſection of theſe two parallels, draw I K, a line perpendicular to the diameter of the horizon. Then ſetting one foote of the compaſſes in L, the midſt of B E the diameter of the Suns almicantar, and ſtretching out the other foote to B the end of this diameter: from thence draw therewith the arch B K till you come to the ſaid perpendicular: This arch reſolued into degrees ſhall giue you the true azimuth of the Sunne.

Now (for them that liſt) by the doctrine of Triangles alſo, M N (the ſine of the Sunnes declination) being giuen, with the angle M O N (equall to the height of the pole) in the right angled Triangle, O N M: the ſide O M ſhall likewiſe bee giuen: which ſubtracted out of M O L (the ſine of the

Sunnes



Sunnes height) there remaine L O, whereby L I, in the Triangle L I O, hauing one right angle at L, and consequently I L K the angle desired, are giuen.



Chap. XIIII.

To finde the inclination or dipping of the magneticall needle vnder the Horizon.

LEt O B R be a meridian of the earth, wherein let O be the pole, B the æquinoctial, R the latitude (ſuppoſe 60 degrees) let B D be perpendicular to A B in B, and equall to the ſubtenſe O B; and drawing the line A D, deſcribe therwith the arch D S V. Then draw the ſubtenſe O R, wherewith

wherewith (taking R for the center) draw the arch O S. To the meeting of these two arches at S, draw the lines R S equall to R O, and A S equall to A D. Also because B R is assumed to be 60 deg. therefore let S T be $\frac{60}{90}$ parts of the arch S T O, and draw the line R T, for the angle A R T shall be the cõplement of the magnetical needles inclinatiõ vnder the Horizon. Which may be found by the solution of the two triangles O A R and R A S, after this manner:

First the angle O A R is giuen because of the arch O B R, measuring the same 150 degr. and consequently the angle at R 15 degr. being equall to the equall legged angle at O; both which together are 30 degr. because they are the complement of the angle O A R (150 degr.) to a semicircle or 180 degr.

Secondly, in the triangle A R S all the sides are giuen A R the Radius or semidiameter 10,000,000 R S equal to R O the subtense of 150 deg. 19,318,516 and A S equall to A D triple in power to A B, because it is equal in power to A B and B D, that is B O; which is double in power to A B. Or else thus: The arch O B being 90 degrees, the subtense therof O B, that is, the tangent B D is 14,142,136, which sought in the table of Tangents, shall giue you the angle B A D 54 degr. 44 min. 8 sec. the secant whereof is the line A D that is A S 17,320,508. Now then by 4 Axiom of the 2 booke of *Pitisc.* as the base or greatest side S R 19,318,516 is to ỹ summe of the other two sides S A and A R 27,320,508; so is the difference of them S X 7,320,508 to the segment of the greatest side S Y 10,352,762; which being taken out of S R 19,318,516, there remaineth Y R 8,965,754

the

the halfe whereof R Z 4,482,877, is the ſine of the angle R A Z 26 degr. 38 min. 2 ſec. the complement whereof 63 degr. 21 min. 58. ſec. is the angle A R Z, which added to the angle A R O 15 degr. maketh the whole angle O R S, 78 degr. 21 min. 58 ſec. whereof $\frac{60}{90}$ make 52 degr. 14 min. 38 ſec. which taken out of A R Z 63 degr. 21 min. 58 ſec. there remaineth the angle T R A 11 deg. 7 min. 20 ſec. the cõplement whereof is the inclination ſought for 78. degrees, 52 minutes, 40 ſeconds.

A ſhorter way to calculate the table of magneticall inclination.

The ſumme and difference of the ſides S A and A R being alwaies the ſame, *viz.* 27,320,508 and 7,320,508, the product of them ſhall likewiſe be alwaies the ſame, *viz.* 199,999,997,378,064 to be diuided by ỹ ſide S R, that is R O the ſubtenſe of R B O. Therefore there may be ſome labour ſaued in making the table of magneticall inclination, if in ſtead of the ſaid product you take continually but ỹ halfe thereof, that is 99,999,998,689,032, and ſo diuide it by halfe the ſubtenſe R O, that is, by the ſine of halfe the arch O B R. Or rather thus: As halfe the baſe R S (that is, as the ſine of halfe the arch O B R) is to halfe the ſumme of the other two ſides S A & A R 13,660,254, ſo is half the difference of thẽ 3,660,254 to halfe of the ſegment S Y, which taken out of half the baſe, there remaineth R Z ỹ ſine of R A Z, whoſe cõplement to a quadrãt is ỹ angle ſought for A R Z.

According to this Diagramme and demonſtration was calculated the table here following; the firſt columne whereof conteineth the height of the pole for euery whole degree; the ſecond columne ſheweth the inclination or dipping of the magnetical needle anſwerable thereto in degr. and minutes.

The

First col.	Second col.		First col.	Second col.		First col.	Second col.	
Height of the Pole.	Magneticall inclination.		Height of the Pole.	Magneticall inclination.		Height of the Pole.	Magneticall inclination.	
Degrees	Degr.	Min.	Degrees.	Degr.	Min.	Degrees	Degr.	Min.
1	2	11	31	52	27	61	79	29
2	4	20	32	53	41	62	80	4
3	6	27	33	54	53	63	80	38
4	8	31	34	56	4	64	81	11
5	10	34	35	57	13	65	81	43
6	12	34	36	58	21	66	82	13
7	14	32	37	59	28	67	82	43
8	16	28	38	60	33	68	83	12
9	18	22	39	61	37	69	83	40
10	20	14	40	62	39	70	84	7
11	22	4	41	63	40	71	84	32
12	24	52	42	64	39	72	84	57
13	25	38	43	65	38	73	85	21
14	27	22	44	66	35	74	85	44
15	29	4	45	67	30	75	86	7
16	30	45	46	68	24	76	86	28
17	32	24	47	69	17	77	86	48
18	34	0	48	70	9	78	87	8
19	35	36	49	70	59	79	87	26
20	37	9	50	71	48	80	87	44
21	38	41	51	72	36	81	88	1
22	40	11	52	73	23	82	88	17
23	41	39	53	74	8	83	88	33
24	43	6	54	74	52	84	88	47
25	44	30	55	75	35	85	89	1
26	45	54	56	76	17	86	89	14
27	47	15	57	76	57	87	89	27
28	48	36	58	77	37	88	89	39
29	49	54	59	78	15	89	89	50
30	51	11	60	78	53	90	90	0

Chap. XV.

Errors in vſing the Croſſe-ſtaffe, and how they may be auoided.

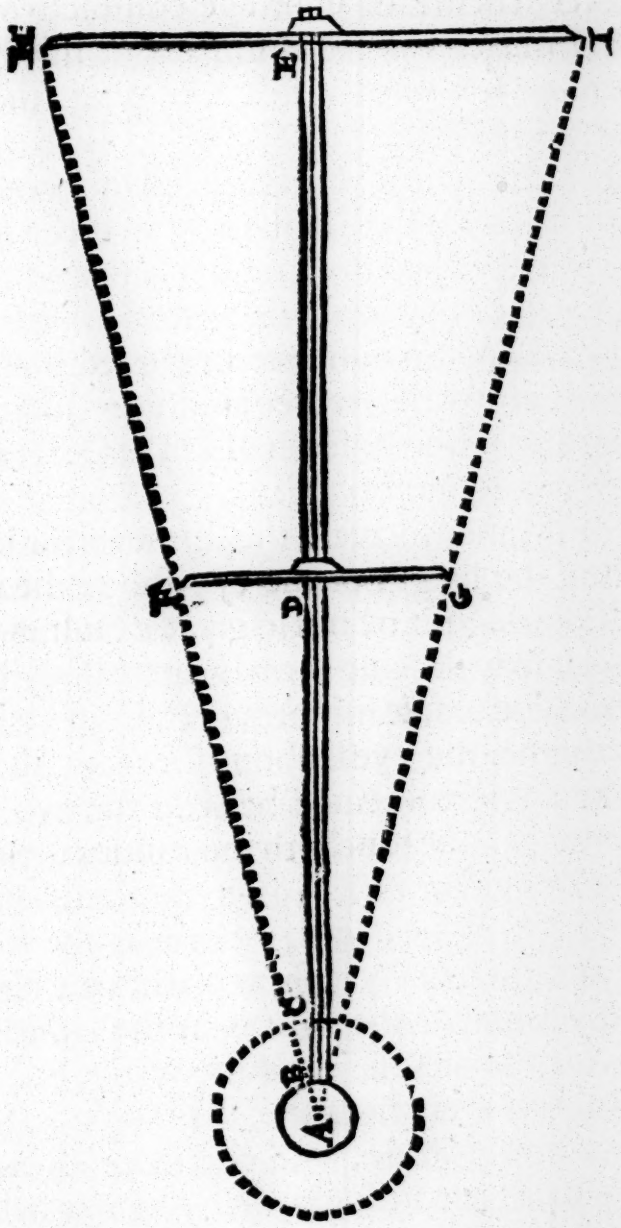
After the Chart and Compaſſe, the croſſe ſtaffe may with good reaſon ſucceed, as in the vſe whereof more error is cõmitted, then in any other inſtrumẽt of Nauigation, the two former excepted, and that foure ſeuerall waies: Firſt in neglecting the paralax or eccentricitie of the eye: Secondly, in not conſidering the height of the eye aboue the water: Thirdly and fourthly, in not regarding the paralax and refraction of the Sunne.

For the firſt, they count the height of the Sunne and Starres in ſuch ſort as if the center of the eye, or vertex of the viſuall cone in vſing the Staffe, were euen with the end thereof that is ſet to the eye. Therefore how much the center of the ſight is diſtant from the end of the Staffe, ſo much are they deceiued. But how much the eccentricitie or paralax of the eye is, it may be knowne after this manner: Make two tranſuerſaries, the one twice ſo long as the other. The longeſt of theſe two ſet faſt at the further end of the index, the other of them moue vp or downe vpon the index, vntill ſuch time that your eye placed at the end of the index (in ſuch ſort as you vſe to place it when you obſerue) you may ſee both ends of both tranſuerſaries lie euen together. For then looke how much the ſegment of the index betwixt the two tranſuerſaries exceedeth the ſegment from the ſhorter tranſuerſaries vnto the

eye, ſo much is the parallax or eccentricitie of your ſight, or the point wherein your eye, wherein the viſuall beames concurre, is ſo much diſtant from the end of the index.

As for example, in this figure let the tranſuerſarie H E I placed at E the end of the index be double to the tranſuerſarie F D G, which is placed in ſuch ſort vpon the index, that the viſual lines (A F H, A G I) of the eye placed at the end of the index, do paſſe ſtraight on by F H and G I, the ends of the tranſuerſaries. For in this figure, A is the center of the ſight or eye, wherein the viſuall lines (A F H, A G I) doe incurre: B repreſenteth the end of the index, placed at the corner of the eye, and then A B is the eccentricitie: C ſignifieth the end of the index ſet againſt the bone vnderneath the eye, for obſeruing of diſtances, and then A C is the eccentricitie, which is thus demonſtrated:

As H E is to F D, ſo E D A to D A, 13. e 5. Ra. But H E is double to F D by ſuppoſition: therfore E D A is double to D A, and D A the half of E D A equal to the other halfe D E. Therefore how much B D or C D is ſhorter then D E, ſo much is the paralax or eccentricitie of the eye, and ſo much muſt the tranſuerſarie be remooued forwards (from the place where he was ſet in the time of your obſeruation) towards the farre end of the index, after you haue obſerued any heigth or diſtance of the Sunne or Starres, that ſo you may haue the true height or diſtance deſired. Or elſe you may haue a plate of braſſe ſo artificially fitted cloſe within, by the ſide of the ſquare hole in the tranſuerſarie, through which the



the index is to be put, that you may ſlip it forwards or backwards like the couer of a boxe, and ſo ſet the fore-edge thereof ſo much before the tranſuerſarie,

as the eccentricitie of your eye commeth to (hauing first turned the flat and streight side of the transuersarie from you ward, and pared the ends thereof, in such sort that the visuall beames may touch the extreames of that side) that so the edge of the plate may at the first shew vpon the index the true heigth or distance of the Sunne or starres obserued without any further correction. Otherwise if this paralax of the sight bee neglected, there may be error of an whole degree and more sometimes in obseruing with those small crosse staues which haue been commonly vsed.

Secondly, they increase the former error by not regarding the heigth of the eye aboue the water. Which although it be not so great a fault as the other, yet it may deceiue them by increasing the former error, fiue or sixe minutes or more in a tall ship. For the higher the eye is aboue the water, the greater is the angle conteined betwixt the two visuall lines, whereof one toucheth the conuex superficies of the sea, the other passeth on to the Sun or starres: And the lower the eye is, the lesse is the foresaid angle: and then onely it sheweth the true altitude, when the center of the sight is in the same line of leuell with the superficies of the water. But if the eye be higher then the water, that angle is greater then the true altitude, and therefore subtraction must be made accordingly, that you may haue the true altitude.

Now to finde how much it is that should be subtracted at any height of the eye aboue the water there be two waies; the one without knowledge of

the

the earths ſemidiameter, the other with knowledge of the ſame. For the firſt, you muſt haue ſome ſuch conuenient place at the water ſide where you may haue a free and cleere proſpect vnto the ſea without impediment, and where you may alſo haue ſuch prouiſion made, that you may place both your ſelfe, and alſo an exact and large water leuell in conuenient manner to make exact obſeruation at what height ſoeuer you deſire aboue the ſuperficies of the ſea, til you come to the height of the talleſt ſhips that goe vpon the ſeas: that leuell hauing the ſight that you muſt looke through at the end therof next the eye ſo fitted, that you may both eaſily and ſteadily ſet it higher then the foreſight (that is the ſight that is at the fore-end of the leuell) ſo much as ſhall be needfull to lay the foreſight preciſely to the touching of the ſea; and that you may alſo perfectly know how much the backſight, or ſight at your eye, is higher then the foreſight aboue the line of leuell: For by the difference of the heights of thoſe ſights aboue the line of leuell, and the diſtance betweene them, it may eaſily be found how much the viſuall line touching the roundnes of the ſea, dippeth vnder the line of leuell, or true Horizon, from whence the height of the ſunne and ſtarres is to be accounted, thus: As the diſtance betwixt the ſights is to the difference of their heights aboue the line of leuell; ſo is the whole ſine to the tangent of the angle of dipping, which we deſired to know.

This angle may otherwiſe be found, the quantitie of the earths ſemidiameter being firſt knowne, which is to be done diuers waies; but they may be

all reduced to two heads or kinds, whereof the firſt requireth the certaine meaſure of ſome arch of the meridian to be firſt giuen, which is alſo diuers waies to be performed. But the beſt and perfecteſt way of all others is to obſerue ſo exactly as is poſſible the ſummer ſolſtitiall altitude of the Sunne at two places, ſo farre diſtãt aſunder, and lying ſo neere North and South each from other with ſo direct and faire a way betweene them as conueniently may be choſen. Suppoſe for example Portſmouth and Barwick, or ſome other place in the furtheſt parts of *Scotland*; for the further theſe places are each from other, the more perfectly may this buſineſſe bee performed. Then meaſure, and plat down ſo truly as is poſſible, all the way betweene thoſe two places, with all the turnings and windings, aſcents and deſcents that are therein; out of which the arch of the great circle, or ſhorteſt diſtance betwixt them, together with the angle of declination thereof from the true meridian line truly found by obſeruation at either of thoſe places, may moſt exactly be knowne: whereby (with helpe of the doctrine of right angled ſphæricall triangles) the difference of the latitudes of thoſe two places in miles and furlongs &c. may eaſily appeare; which compared with the difference of the latitudes of the ſame places, found by obſeruation of the Sun in degrees and minutes, &c. will ſhew how many miles and furlongs anſwer to one, or moe degrees of the meridian: and ſo the whole circumference, diameter, and ſemidiameter of the earth will eaſily, and more truly be found, then any other way yet vſed for this purpoſe. But meanes

A moſt exact way to finde the quantitie of the eaths ſemidiameter.

conuenient

conuenient for the triall hereof haue hitherto been wanting, and ſo I muſt omit it till ſome better opportunitie, if any ſhall befall hereafter by the bountie of any ſuch as are of more abilitie to beare the charge hereof. Yet beſides our purpoſe now in hand, this would bee the beſt ground that can be, both for the making and continuing of a ſtandard, and all other meaſures thereon depending, at a certaintie for euer; inſomuch that although all the ſtandards, weights and meaſures in the world were loſt, they might notwithſtanding vpon record of ſuch obſeruation, and meanes, as here we mentioned, be againe reſtored much more perfectly, then by the ordinary way of beginning all our meaſures from a barly graine taken out of the midſt of the eare, whereof there is no ſuch certaine determinate bigneſſe that can be ſet downe, but that they may bee ſomething greater in one eare then another; neither can there be any certaine rule or reaſon giuen how to know which eare to chuſe rather then other, for this purpoſe. And if any error be committed herein, though inſenſible (which cannot be auoided) yet in going about to make other greater meaſures by often taking this leaſt, and ſo proceeding *à minimis ad maxima*, ſo often as you take your firſt or leaſt meaſure, ſo often doe you increaſe and multiplie your error: which though at the firſt it ſeeme very ſmall and ſcarcely perceiuable, yet commeth at the laſt to be very notorious & intollerable. But the other way I here ſpeake of, taking the length of all *England*, or of the whole Iland, for our firſt meaſure, and out of it by ſubdiuiſion, diuiding all

the reſt, although wee may erre ſomething in taking the length hereof (which notwithſtanding, I dare vndertake, may be ſo handled, that it ſhall not be ſo much as the thouſand part of the whole diſtance betweene the two places, before mentioned) yet becauſe we proceed *à maximis ad minima*, ſo ſtill diuiding, and the more diminiſhing this error, the further we proceed; it will in the end, when we come to our ordinarie meaſures moſt in vſe, become very inſenſible and not worth the regarding.

But to returne to our purpoſe from whence we haue a little digreſſed: The earths ſemidiameter may in like manner be found by obſeruation of the meridian altitudes of any notable fixed ſtarre at the two places before mentioned: but becauſe the heights of ſtars cannot by any meanes be ſo exactly obſerued as the height of the Sunne may be; the difference of the latitudes of the two places, and conſequently the perimeter (that is the circuite or compaſſe) and the diameter of the earth cannot be ſo perfectly found by this way as by the former.

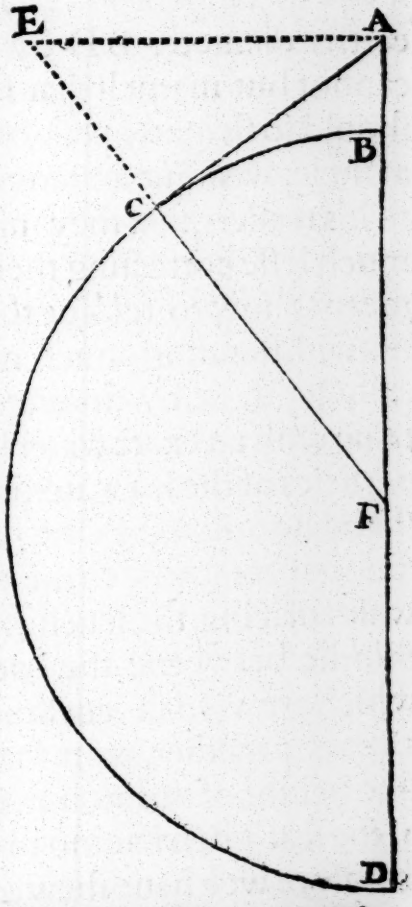
As for that way which findeth the height of the Sunne and ſo the latitudes, by the length of the ſhadow of a ſtile or gnomon perpendicularly erected, it is like to be more vncertaine then either of the former, by reaſon of the ſcattering and vncertaine determining of the end of the ſhadow; beſide the knowledge of the Sunnes ſemidiameter hereunto required, which inconueniences may in the former waies be auoided.

The quantitie of the earths diameter is alſo to be found more eaſily, though not ſo exactly (without obſeruing

obſeruing any height of ſunne or ſtarre, or meaſuring any arch of the meridian) by meanes of ſome great height giuen neere the ſea ſide; as namely the height of ſome high mountaine, from whoſe top you may haue a free proſpect ſo farre as you can ſee vpon the ſea. Which *Maurolycus* endeuoureth to doe after this manner:

Clau. Comm. in 1. Cap. Ioan. de Sacroboſc.

Let B C D be the circuit of ỹ earth A B the height of ſome high mountaine to bee found by the rules of meaſuring heights (But heere hee ſhould haue done well to haue ſhewed vs by what rules; for the ordinarie rules will not ſerue the turne) A C a viſual line from the top of the mountaine to C the point of the touching thereof with the ſea or plain land where no hils are; (but ſuch land wil very hardly be foũd that may ſerue for this purpoſe) C B the diſtance (without ſenſible error) of that point of touching from the perpendicular ſhewing the height of the mountaine; to be found alſo by the rules of meaſuring lengths ſo farre as we can ſee frõ the top of the mountain A.

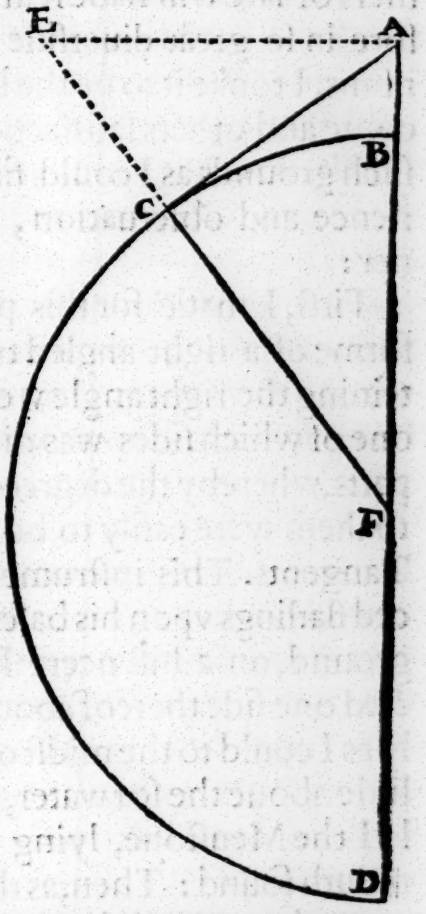


(But

Maurolycus and *Clauius* his groſſe demonſtration.

(But here alſo he ſhould haue ſhewed ſome certain rule how to find both the point of touching C, and alſo the diſtance to it from B, and not ſo groſſely to ſlubber ouer ſo nice a point as this is, in bidding vs meaſure ſo farre as we can ſee) Then rudely taking A B C for a plaine right angled triangle with the ſides A B and B C found as before, we may without any further rubbe, proceed, and finde both the *hypotenuſa* or tangent A C by the 47.1 *Eucl.* as alſo the earths diameter B D by the 37.3 *Eucl.* Yet here I cannot but maruell that ſo great a Clerke as *Clauius* ſhould ſo ſleightly paſſe ouer ſuch groſſe abſurdities as theſe, without any touch or warning at all giuen to his readers, that they might not be abuſed by thé; much leſſe correcting them, or ſhewing any better meanes how to reſolue this probleme; which may notwithſtanding much more eaſily and geometrically be done by finding the height of the mountaine with an exact water leuell, beginning at the ſuperficies of the ſea water, in ſome creeke where it reſteth ſmooth and calme; and from thence proceeding till you come to the top of the mountaine, alwaies placing the leuell (ſo neere as may be) in the middle betweene the backmarke and foremarke, which are vſed in leuelling, and ſo adding all your aſcents together, you ſhall haue very exactly the true height of the mountaine aboue the roundneſſe of the ſea. Then hauing the ſights fitted in ſuch ſort, as before wee haue ſhewed, that you may raiſe the backſight (or ſight at your eye) higher then ỹ foreſight (at the farre end of the leuell) ſo much as ſhall be needfull; place the leuell, ſo truly and ſteadily as you

you can, vpon the top of the mountaine; and ſo diſpoſe the ſight at your eye, that you may ſee the foreſight lie euen with the touching of the ſea, whereby the angle of depreſſion or dipping of the viſuall line vnder the line of leuell may be found by the difference of the heights of ỹ ſights, as before is ſhewed. And then as the exceſſe of the ſecant of that angle aboue the whole ſine, is to the whole ſine: ſo is the height of the mountaine AB (already foũd) to the ſemidiameter of the earth, B F. For F C being continued to E and A E repreſenting the line of leuell or true horizõ; E A C the angle of dipping ſhalbe equal to the angle A E C (by 16.3 and 8. *6 Euct*) the ſecant whereof is A F; the whole ſine B F (proportionall to the earths ſemidiameter) and the difference of them A B, proportionall to the height of ỹ mountaine.



But hauing not hitherto had meanes requiſite to make triall of any of theſe waies alreadie mentioned, I haue thought of another way, whereby the height of the mountaine, and conſequently the quantitie of the earths

ſemidiameter

ſemidiameter may bee knowne; wherein becauſe there is great varietie of opinions amongſt the ancient and later writers, ſome making it to be almoſt 8000 miles; ſome little more thē 5500, ſome others not much exceeding 5000; others making it leſſe then 3600; and others not much more then 3200, as *Alphraganus*, though *Fernelius*, according to his obſeruation, findes it to bee 3900 miles, whereas others of late will haue it little more then 3000: therfore in ſo great diuerſitie and vncertaintie of opinions, I tooke it to be the beſt courſe, both for mine owne and others ſatisfaction, to reſt my ſelfe vpon ſuch grounds as I could finde by mine owne experience and obſeruation, and that after this manner:

Firſt, I made for this purpoſe an inſtrument in forme of a right angled triangle, whoſe ſides conteining the right angle were about ſixe foote long; one of which ſides was diuided into 10,000 equall parts, whereby the degrees and minutes anſwerable to them were eaſily to be found out of the table of Tangents. This inſtrument thus prepared and placed flatlings vpon his baſes about three foote aboue ground, on a hill neere Plimmouth ſound, I directed one ſide thereof about the right angle as exactly as I could to the midſt of a ſmall rock, appearing a little aboue the ſea water, neere the great Rock called the Meuſtone, lying at the entrance of Plimmouth ſound: Then, as the other ſide of the inſtrument about the right angle directed me, I tooke my ſecond ſtanding 664 foote by iuſt meaſure from the firſt; which diſtance was ſo much as the ground would

would well giue me leaue to take, for otherwise I would haue gone further. At this second station I found the angle conteined betweene the visuall lines directed to the first station and that small rock to be 87 degrees,52 minutes; the tangent whereof is 26,845 such parts whereof the distance of the standing or whole sine conteineth 1000: whereby the distance from the first station to the said small rock was found to be 17,825 foote: for as 1000 to 26,845; so are 664 foote to 17,825 foote.

Then comming againe to the first station, and setting the Instrument steadie vp on edge, I first directed one of the sides about the right angle (lying neere the ground) to the said little rock; and then a plumbline hanging at the vpper corner of this Triangular Instrument, did fall 1 degree 14 minutes from the right angle forwards. After this I directed the same side, as truly as I could, to the very touching of the sphæricall superficies of the Sea; and then the plumbline fell 22 minutes from the same right angle forwards, towards the sea.

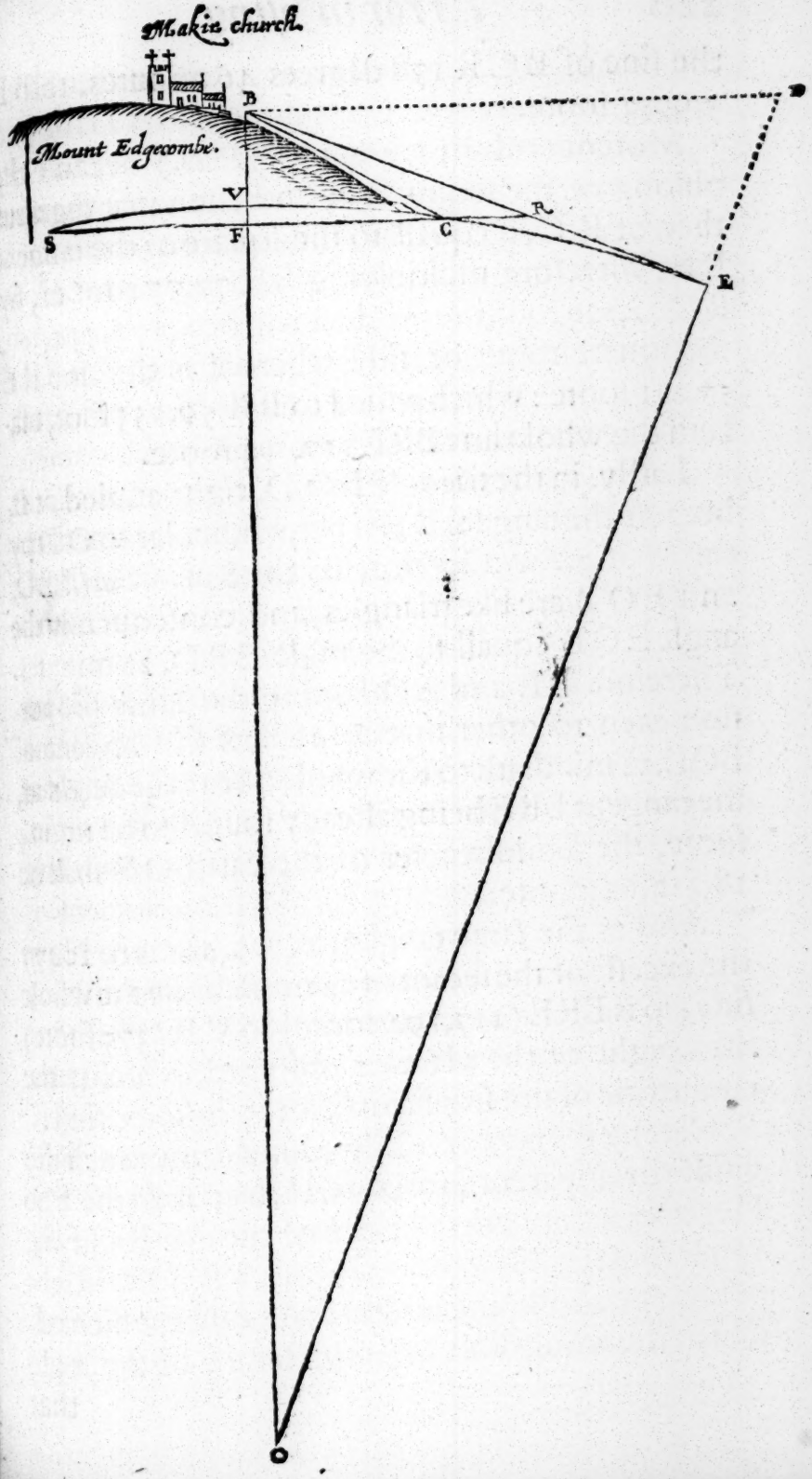
Out of these obseruations the semidiameter of the earth was found, thus: Let O be the center of the earth, S V C E the circumference of the sea: B the place of obseruation, B V F O a perpendicular line drawne from thence to the center of the earth: B D, the line of leuell or true Horizon: B C, the distance from the place of obseruation to the marke in the sea 17,825 foote: the angle C B D found by obseruation 1. degree 14 minutes: B R E a visuall line from the place of obseruation touching the sea: E, the point of touching: E B D, the angle betwixt that

that viſuall line and the line of leuell or true Horizon 22 minutes: R C F S, a parallel to B D, or line of leuell, drawne by the marke C: O F V, and O P, ſemidiameters of the ſeas circumference at the time of obſeruation: E D, the continuation of the ſemidiameter O E to the line of leuell or true Horizon B D.

Now in the triangle B C F, right-angled at F, the ſide B C being 17,825 foote, and the angle at B, 88 degrees 46 minutes (becauſe it is the complement of the angle C B D 1 degree 14 minutes) the ſide F C ſhall be 17,821 foote; which doubled maketh C F S 35,642 foote, and the angle at C (being the complement of the angle at B) is 1 degr. 14 minutes.

Then in the triangle B C R, the angle at C (being the complement of the angle B C F to a ſemicircle) is 178 degrees 46 minutes, and the angle at B (being the difference of the angles D B R 22 min. and D B C, 1 degr. 14 minutes) ſhall be 52 min. and conſequently the angle at R (the complement of the two former, to two right angles) 22 min. Now becauſe in all plaine triangles the ſides and ſines of the oppoſite angles are proportionall; therefore as 63,995 (the ſine of B R C 22 minutes, in ſuch parts whereof the whole ſine conteineth 10,000,000) is to B C 17,825 foote; ſo is 151,256 the ſine of C B R 52 min. to C R, 42,130 foot: which added to C F S 35,642 foote, giueth you the whole line R C F S, 77,772 foote.

Alſo in the ſame triangle as 63,995 the ſine of B R C 22 min. is to B C 17,825 foote; ſo is 215,241 the


Maker church.
Mount Edgecombe.
B
V
S
F
C
R
E
O

the ſine of B C R 178 degrees 46 minutes, to B R 59,953 foote.

Moreouer (by the 36 prop. 3 *Eucl.*) becauſe the oblong of the ſecant R S, and the vtter ſegment thereof R C, is equall to the ſquare of the tangent R E; therefore multiplying S R 77,772 foote, by R C 42,130 foot, the product will be 3,276,534,360, the ſquare roote or ſide whereof is the line R E 57,241 foote: which added to B R 59,953 foot, maketh the whole line B R E 117,194 foote.

Laſtly, in the triangle B O D, right-angled at B, becauſe the tangent B E is perpendicular to O D by the 16 pr. 3. *Eucl.* therefore by the 8 pr. 6. *Eucl.* E B D, and E O B are like triangles, and conſequently the angle E O B equall to the angle E B D, 22 minutes. Therefore B E and E O hauing the ſame proportion each to other that 6,399,628 the tangent of B O E, 22 min. hath to the whole ſine 100,000,0000, the tangent B R E being already found to be 117,194 foote, the ſemidiameter of the earth O E ſhall be 18,312,621 foote.

And as the ſame tangent 6,399,628 is to 20477 the exceſſe of the ſecant of 22 min. aboue the whole ſine; ſo is B R E (117,194 foote) to V B (375 foote) the height of the place of obſeruation aboue the conuexitie of the ſeas ſuperficies at the ſame time.

Hereby it may bee eaſily found, how much the viſible or apparent Horizon is lower then the true Horizon, at any other height of the eye aboue the water, thus: As 375 is to 20477, ſo is any other height of the eye aboue the water to a number, which added to the whole ſine, maketh ỹ ſecant of the angle

that

that ſheweth how much the apparent Horizon dippeth vnder the true Horizon at that height.

As for example: if the height of your eye aboue the water be 20 foote, you ſhall finde by the former rule the fourth proportionall number to bee 1092, which added to the whole ſine 1,000,000,000,000, maketh 1,000,001,092; which is the ſecant of 5 min. 5 ſec. the angle of dipping anſwerable to that height.

After this manner was made this table here adioyned; in the firſt colũne wherof is ſet down the height of the eye aboue the water, from one foot to 50. The ſecond columne ſheweth how much the viſuall line touching the ſea, dippeth vnder the true Horizon, at any height of the eye aboue the water not exceeding 50 foote. The vſe of which table is this: When you obſerue the height of the ſunne or ſtars at ſea with the Croſſe-ſtaffe, you ſhall alſo finde out how many foot high your eye is aboue the water with a plumbline or otherwiſe: ſeeke that height in the firſt columne of this table;

Height of the eye.	*Angle of dipping.*	
Foote.	*Min.*	*Sec.*
1	1	8
2	1	36
3	1	58
4	2	16
5	2	33
6	2	47
7	3	0
8	3	13
9	3	24
10	3	35
12	3	56
14	4	15
16	4	33
18	4	50
20	5	5
22	5	20
24	5	34
26	5	48
28	6	1
30	6	13
32	6	25
34	6	38
36	6	49
38	7	0
40	7	11
42	7	21
44	7	32
46	7	42
48	7	52
50	8	2

and in the ſecond volume intituled *Angle of dipping* you ſhall finde the number of minutes and ſeconds that are to be ſubtracted from the apparent height of the Sunne or Starres aboue the ſuperficies of the ſea, obſerued with the Staffe, that you may haue the apparent height aboue the true Horizon.

The third error hath place in taking the height of the Sunne or Moone with the Staffe, ring, quadrant, or Aſtrolabe, or any other inſtrument, whether by ſea or land: but in taking the height of the fixed ſtarres, this error is not to be regarded, being altogether inſenſible, by reaſon of their exceeding great diſtance from the earth, which is ſo much, that in compariſon thereof the ſemidiameter of the whole earth hath not any ſenſible proportion, and therefore the fixed Starres cannot haue any ſenſible paralax. But the Sunne by reaſon of his leſſer diſtance from the earth, hath a ſenſible paralax: in ſo much that in taking his height, wee may for this cauſe onely bee deceiued ſometimes about three minutes, by counting it leſſe then indeede it is, and that eſpecially in winter time, when the ſunne draweth neere the Horizon: which although it be no great error, yet it is not altogether to be neglected in the rules and grounds of Art, which ſo much as is poſſible ought to be without error.

For this cauſe I haue adioyned this table following of the Sunnes paralax: the vſe whereof is this, in the firſt columne intituled the heigth of the Sunne, looke the Suns apparent heigth, and in the ſame line in the ſecond columne, you ſhall haue the paralax of the ſun, which alwaies is to be added to the apparent heigth, that ſo you may haue the true heigth of the ſunne aboue the Horizon. As for example, admit I finde the apparent heigth of the ſun to be 25 degrees, therefore I ſeeke that number in the firſt columne, and in the ſecond columne I finde the paralax anſwerable thereto to be two minutes, 44 ſeconds, which added to 25 degrees, make the true height of the Sunne to be 25 degrees, two minutes, 44 ſec.

The height of the Sun	*The paralax of the Sunne*	
Degr.	*Mi.*	*Sec*
0	3	0
5	2	59
10	2	57
15	2	54
20	2	50
25	2	44
30	2	36
35	2	27
40	2	18
45	2	7
50	1	56
55	1	43
60	1	30
65	1	16
70	1	2
75	0	46
80	0	31
85	0	15

A fourth cauſe of error is the refraction of the beames of the ſun or ſtars, which we obſerue, by reaſon of the vaporous thickneſſe of the ayre that is betwixt vs and them, eſpecially when they are neare the Horizon. For the finding whereof; not hauing hitherto had ſufficient meanes by mine owne obſeruation for my full ſatisfaction herein: I haue there-

fore thought good to adioyne theſe tables of the Suns & fixed Starres refractions out of *Tycho Brahe*, which differ little frō ſuch obſeruatiōs as I haue made for triall hereof: the vſe wherof is this: In the firſt columne ſeeke the altitude or height of the Sun or fixed Star, & in the ſecond you ſhall haue the refraction anſwering therto, which being ſubtracted out of the obſerued height, you ſhal haue the height of the Sunne or Starre remaining, without refraction.

The Sunnes		*The Sunnes*		*The fixed Starres*	
Altitude.	*Refraction.*	*Altitude*	*Refraction.*	*Altitude.*	*Refraction.*
De.	*Mi. Se.*	*De.*	*Mi. Se.*	*De.*	*Mi. Se.*
0	34 0	23	3 10	0	30 0
1	26 0	24	2 50	1	21 30
2	20 0	25	2 30	2	15 30
3	17 0	26	2 15	3	12 30
4	15 30	27	2 0	4	11 0
5	14 30	28	1 45	5	10 0
6	13 30	29	1 35	6	9 0
7	12 45	30	1 25	7	8 15
8	11 15	31	1 15	8	6 45
9	10 30	32	1 5	9	6 0
10	10 0	33	55	10	5 30
11	9 30	34	45	11	5 0
12	9 0	35	35	12	4 30
13	8 30	36	30	13	4 0
14	8 0	37	25	14	3 30
15	7 30	38	20	15	3 0
16	7 0	39	15	16	2 30
17	6 30	40	10	17	2 0
18	5 45	41	9	18	1 30
19	5 0	42	8	19	1 0
20	4 30	43	7	20	0 30
21	4 0	44	6	21	0 0
22	3 30	45	5		

CHAP.

Chap. XVI.

Faults amended in the Table of the Sunnes declination: commonly called the Regiment of the Sunne.

NOtwithstanding the Sunne and Starres are at sea the most certaine markes and guids the Nauigator hath, whereby he may direct himselfe to rectifie his course, and know where he is after many turnings, and trauersings this way and that way, especially in long voiages, wherein he may be forced many times by contrarie winds and calmes, to sing with the Poet for many weekes and monethes together.

Cælum vndique & vndique pontus: and
Nihil est nisi pontus & æther:

Yet the Tables of declinations of the Sunne and fixed Starres hitherto published, which I haue compared together and examined by obseruation, are oft times very faultie: the declination of the Sunne in them set downe, being many times lesse then truth, by 10, 11, or 12 minutes, especially in the monethes of Februarie and March: and some of the principall fixed Starres that are of most vse in Nauigation, differing in declination from that is set downe in the

Tables more then one whole degree, as I haue found by many obſeruations.

For the eaſier mending of theſe faults in the Tables of the Sunnes declination, I thought it meete firſt to ſet downe the Table following, which ſheweth the declination of euery minute of the ecliptike in degrees, minutes, and ſeconds, whereby the place of the Sunne is preſently knowne, his declination being firſt giuen by obſeruation, and conſequently, his eccentricitie and apogęum were eaſily found, and the theoricke of the Sunne corrected: out of which the Ephemerides hereafter following, were calculated, ſhewing the true place of the Sunne for euery day of fiue yeares, agreeable, (without notable error) to the truth of the heauens: and out of theſe with helpe of this Table of declination, a new regiment (or table of the Sunnes declination, for euery day of fiue yeares) was moſt eaſily made: free from ſuch errors wherewith the tables hitherto publiſhed and commonly vſed, haue been too much peſtered: as by compariſon of this, and thoſe tables with the obſeruations hereafter following may euidently appeare.

CHAP.

Chap. XVII

Of the Table of declination of euery minute of the Ecliptick in degrees, minutes and ſeconds: Made according to the greateſt obliquitie of the zodiak this preſent age; which by exact obſeruation, is found to be 23 degrees 31 minutes and an halfe.

BEcauſe the table of declination heere following, doth differ ſomething from the Tables heretofore publiſhed by others, whereof ſome make the greateſt declination of the Sunne to be 23 degr. and 28 minutes only, as *Copernicus* and his followers (according to which the tables of declination and regiments of the Sunne, that haue been vſed for the moſt part by our Engliſh Mariners are made): whereas others of late, as that noble Aſtronomer *Tycho Brahe* in his ſecond booke *De recentioribus ætherei mundi phænomenis*, findeth the ſame to bee by his obſeruations 23 degr. 27 mi. pag. 38. 23 degr. 31 mi. pag. 386. 23 degr. 31 mi. 30 ſec. pag. 217. (according to which there is a table of declination alreadie publiſhed by *Maginus*) and that excellent Geometrician *Regiomontanus* (whom *Petrus Nonius* compared by *Ramus* to *Archimedes* and *Clauius*, choſe rather to follow) maketh it to be but 23 degr. 30 min. I thought it therefore needfull to ſhew what reaſons moued

me to make choiſe of the greateſt of all the declinations before recited, being thereunto induced, not only by the authoritie of that famous Aſtronomer of our time *Tycho Brahe:* but reſting alſo vpon many and diligent obſeruations of mine owne, (taken by a quadrant of more then ſixe foot ſemidiameter, ſo exactly made and diuided into minutes and halfe minutes, as I could, and as heedfully vſed and truly rectified by a plumbline (euery time I obſerued as my ſight could diſcerne:) All which obſeruations do proue with one conſent, that the greateſt declination of the Sunne in this our age, is 23 degrees, 31 minutes and an halfe; as thus it may appeare.

In the yeare 1594 the 11 and 12 daies of Iune, the apparent meridian altitude of the Sunne was obſerued to be 61 degr. 58 min. whereto the obſeruations of the 8, 9, 10, 13, 14 and 15 daies of the ſame moneth do well agree, wherein the apparent meridian altitudes of the Sunne, were 61 degr. 55 mi. ½ 61 degr. 56 mi. ½ 61 degr. 57 mi. 61 degr. 57 mi. ½ 61 degr. 57 mi. 61 degr. 56 mi. almoſt, as alſo the obſeruations of the 9, 11, 12, and 13 daies of Iune, in the yeare 1597 in which daies the apparent meridian altitudes of the Sunne, were 61 degr. 57 mi. 61 degr. 58 ½ mi. almoſt, 61 degr. 58 mi. 61 degr. 57 mi. ½. By all which obſeruations it may be certainly concluded, that the greateſt apparent height of the Sunne here at London, is 61 degr. and 58 minutes.

Moreouer by many, and heedfull obſeruations of the Pole-ſtarre, taken about the yeare 1593 and 1594 I found the greateſt height thereof at that time heere in London, to be 54 degrees, 24 minutes and a halfe,

halfe, and the leaſt height 48 degr. 39 minutes ½ the differẽce of which heights is 5 degrees 45 minutes: the halfe whereof is 2 degrees 52 min. ½ that is, (the diſtance of the Pole-ſtarre from the Pole) at that time added to the loweſt height of the Pole-ſtarre, ſheweth the height of the Pole at *London*, to be 51 degrees, 32 minutes: the complement whereof (38 degrees, 28 minutes) is the height of the æquinoctiall, which ſubtracted out of the greateſt apparent height of the ſunne, 61 degrees 58 minutes: there remaineth the greateſt apparent declination of the ſunne, 23 degrees 30 minutes: whereto if we adde 1 minute, 22 ſeconds, that is the paralax of the ſunne anſwerable to that height, we ſhall haue the greateſt true height of the ſunne, 61 degrees, 59 minutes, 22 ſeconds, and conſequently the greateſt true declination of the ſunne for our time, 23 degrees, 31 minutes, 22 ſeconds, differing but halfe a quarter of one minute from the greateſt declination finally determined and reſoluedly ſet down by *Tycho Brahe* for this our age 23 degrees, 31 minutes and one halfe.

	Deg. 0			dif.	Deg. 1			dif.	Deg. 2			dif.	
mi.	Deg.	Mi.	Se	Se.	Deg.	Mi	Se	Se.	Deg.	Mi.	Se	Se.	mi.
0	0	0	0	24	0	23	57	24		47	53	24	60
1	0	0	24	24	0	24	21	24	0	48	17	24	59
2	0	0	48	24	0	24	45	24	0	48	41	24	58
3	0	1	12	24	0	25	9	24	0	49	5	24	57
4	0	1	36	24	0	25	33	24	0	49	29	24	56
5	0	2	0	24	0	25	57	24	0	49	53	24	55
6	0	2	24	24	0	26	21	23	0	50	17	24	54
7	0	2	48	24	0	26	44	24	0	50	41	24	53
8	0	3	12	24	0	27	8	24	0	51	5	24	52
9	0	3	36	24	0	27	32	24	0	51	29	24	51
10	0	4	0	23	0	27	56	24	0	51	53	24	50
11	0	4	23	24	0	28	20	24	0	52	17	24	49
12	0	4	47	24	0	28	44	24	0	52	41	24	48
13	0	5	11	24	0	29	8	24	0	53	5	23	47
14	0	5	35	24	0	29	32	24	0	53	28	24	46
15	0	5	59	24	0	29	56	24	0	53	52	24	45
16	0	6	23	24	0	30	20	24	0	54	16	24	44
17	0	6	47	24	0	30	44	24	0	54	40	24	43
18	0	7	11	24	0	31	8	24	0	55	4	24	42
19	0	7	35	24	0	31	32	24	0	55	28	24	41
20	0	7	59	24	0	31	56	24	0	55	52	24	40
21	0	8	23	24	0	32	20	24	0	56	16	24	39
22	0	8	47	24	0	32	44	24	0	56	40	24	38
23	0	9	11	24	0	33	8	24	0	57	4	24	37
24	0	9	35	24	0	33	32	23	0	57	28	24	36
25	0	9	59	24	0	33	55	24	0	57	52	24	35
26	0	10	23	24	0	34	19	24	0	58	16	24	34
27	0	10	47	24	0	34	43	24	0	58	40	24	33
28	0	11	11	24	0	35	7	24	0	59	4	23	32
29	0	11	35	23	0	35	31	24	0	59	27	24	31
30	0	11	58		0	35	55	24	0	59	51	24	30
	29				28				27				

	0 Deg.	dif	1 Deg	dif	2 Deg.	dif.	
mi.	Deg. Mi. Se	Se.	Deg. Mi. Se.	Se.	Deg. Mi. Se.	Se.	mi.
30	0 11 58	24	0 35 55	24	0 59 51	24	30
31	0 12 22	24	0 36 19	24	1 0 15	24	29
32	0 12 46	24	0 36 43	24	1 0 39	24	28
33	0 13 10	24	0 37 7	24	1 1 3	24	27
34	0 13 34	24	0 37 31	24	1 1 27	24	26
35	0 13 58	24	0 37 55	24	1 1 51	24	25
36	0 14 22	24	0 38 19	24	1 2 15	24	24
37	0 14 46	24	0 38 43	24	1 2 39	24	23
38	0 15 10	24	0 39 7	24	1 3 3	24	22
39	0 15 34	24	0 39 31	24	1 3 27	24	21
40	0 15 58	24	0 39 55	24	1 3 51	24	20
41	0 16 22	24	0 40 19	23	1 4 15	24	19
42	0 16 46	24	0 40 42	24	1 4 39	23	18
43	0 17 10	24	0 41 6	24	1 5 2	24	17
44	0 17 34	24	0 41 30	24	1 5 26	24	16
45	0 17 58	24	0 41 54	24	1 5 50	24	15
46	0 18 22	24	0 42 18	24	1 6 14	24	14
47	0 18 46	24	0 42 42	24	1 6 38	24	13
48	0 19 10	23	0 43 6	24	1 7 2	24	12
49	0 19 33	24	0 43 30	24	1 7 26	24	11
50	0 19 57	24	0 43 54	24	1 7 50	24	10
51	0 20 21	24	0 44 18	24	1 8 14	24	9
52	0 20 45	24	0 44 42	24	1 8 38	24	8
53	0 21 9	24	0 45 6	24	1 9 2	24	7
54	0 21 33	24	0 45 30	24	1 9 26	24	6
55	0 21 57	24	0 45 54	24	1 9 50	23	5
56	0 22 21	24	0 46 18	24	1 10 13	24	4
57	0 22 45	24	0 46 42	24	1 10 37	24	3
58	0 23 9	24	0 47 6	23	1 11 1	24	2
59	0 23 33	24	0 47 29	24	1 11 25	24	1
60	0 23 57	24	0 47 53	24	1 11 49	24	0
	29		28		27		

	3			dif	4			dif	5			dif	
mi.	Deg.	Mi.	Sc.	Se.	Deg.	Mi.	Sc.	e	Deg.	Mi.	Sc	Se.	mi.
0	1	11	49	24	1	35	44	24	1	59	37	24	60
1	1	12	13	24	1	36	8	24	2	0	1	24	59
2	1	12	37	24	1	36	32	24	2	0	25	24	58
3	1	13	1	24	1	36	56	23	2	0	49	24	57
4	1	13	25	24	1	37	19	24	2	1	13	23	56
5	1	13	29	24	1	37	43	24	2	1	36	24	55
6	1	14	13	24	1	38	7	24	2	2	0	24	54
7	1	14	37	24	1	38	31	24	2	2	24	24	53
8	1	15	1	23	1	38	55	24	2	2	48	24	52
9	1	15	24	24	1	39	19	24	2	3	12	24	51
10	1	15	48	24	1	39	43	24	2	3	36	24	50
11	1	16	12	24	1	40	7	24	2	4	0	23	49
12	1	16	36	24	1	40	31	23	2	4	23	24	48
13	1	17	0	24	1	40	54	24	2	4	47	24	47
14	1	17	24	24	1	41	18	24	2	5	11	24	46
15	1	17	48	24	1	41	42	24	2	5	35	24	45
16	1	18	12	24	1	42	6	24	2	5	59	24	44
17	1	18	36	24	1	42	30	24	2	6	23	24	43
18	1	19	0	24	1	42	54	24	2	6	47	24	42
19	1	19	24	24	1	43	18	24	2	7	11	23	41
20	1	19	48	23	1	43	42	24	2	7	34	24	40
21	1	20	11	24	1	44	6	24	2	7	58	24	39
22	1	20	35	24	1	44	30	23	2	8	22	24	38
23	1	20	59	24	1	44	53	24	2	8	46	24	37
24	1	21	23	24	1	45	17	24	2	9	10	24	36
25	1	21	47	24	1	45	41	24	2	9	34	24	35
26	1	22	11	24	1	46	5	24	2	9	58	23	34
27	1	22	35	24	1	46	29	24	2	10	21	24	33
28	1	22	59	24	1	46	53	24	2	10	45	24	32
29	1	23	23	24	1	47	17	24	2	11	9	24	31
30	1	23	47	24	1	47	41	24	2	11	33	24	30
		26				25				24			

mi.	3 Deg. Mi. Se	dif. Se.	4 Deg. Mi. Se.	dif. Se	5 De. Mtn. Se.	dif. Se.	mi.
30	1 23 47	24	1 47 41	24	2 11 33	24	30
31	1 24 11	23	1 48 5	23	2 11 57	24	29
32	1 24 34	24	1 48 28	24	2 12 21	24	28
33	1 24 58	24	1 48 52	24	2 12 45	23	27
34	1 25 22	24	1 49 16	24	2 13 8	24	26
35	1 25 46	24	1 49 40	24	2 13 32	24	25
36	1 26 10	24	1 50 4	24	2 13 56	24	24
37	1 26 34	24	1 50 28	24	2 14 20	24	23
38	1 26 58	24	1 50 52	24	2 14 44	24	22
39	1 27 22	24	1 51 16	23	2 15 8	23	21
40	1 27 46	24	1 51 39	24	2 15 31	24	20
41	1 28 10	24	1 52 3	24	2 15 55	24	19
42	1 28 34	23	1 52 27	24	2 16 19	24	18
43	1 28 57	24	1 52 51	24	2 16 43	24	17
44	1 29 21	24	1 53 15	24	2 17 7	24	16
45	1 29 45	24	1 53 39	24	2 17 31	24	15
46	1 30 9	24	1 54 3	24	2 17 55	23	14
47	1 30 33	24	1 54 27	24	2 18 18	24	13
48	1 30 87	24	1 54 51	23	2 18 42	24	12
49	1 31 21	24	1 55 14	24	2 19 6	24	11
50	1 31 45	24	1 55 38	24	2 19 30	24	10
51	1 32 9	24	1 56 2	24	2 19 54	24	9
52	1 32 33	24	1 56 26	24	2 20 18	23	8
53	1 32 57	23	1 56 50	24	2 20 41	24	7
54	1 33 20	24	1 57 14	24	2 21 5	24	6
55	1 33 44	24	1 57 38	24	2 21 29	24	5
56	1 34 8	24	1 58 2	23	2 21 53	24	4
57	1 34 32	24	1 58 25	24	2 22 17	24	3
58	1 34 56	24	1 58 49	24	2 22 41	24	2
59	1 35 20	24	1 59 13	24	2 23 5	23	1
60	1 35 44	24	1 59 37	24	2 23 28	24	0
	26		25		24		

mi.	6 Deg. Mi. Se.	dif Se.	7 Deg. Mi. Se.	dif Se.	8 Deg. Mi. Se.	dif Se.	mi.
0	2 23 28	24	2 47 18	23	3 11 4	24	60
1	2 23 52	24	2 47 41	24	3 11 28	24	59
2	2 24 16	24	2 48 5	24	3 11 52	23	58
3	2 24 40	24	2 48 29	24	3 12 15	24	57
4	2 25 4	24	2 48 53	24	3 12 39	24	56
5	2 25 28	23	2 49 17	23	3 13 3	24	55
6	2 25 51	24	2 49 40	24	3 13 27	23	54
7	2 26 15	24	2 50 4	24	3 13 50	24	53
8	2 26 39	24	2 50 28	24	3 14 14	24	52
9	2 27 3	24	2 50 52	23	3 14 38	24	51
10	2 27 27	24	2 51 15	24	3 15 2	23	50
11	2 27 51	23	2 51 39	24	3 15 25	24	49
12	2 28 14	24	2 52 3	24	3 15 49	24	48
13	2 28 38	24	2 52 27	24	3 16 13	24	47
14	2 29 2	24	2 52 51	23	3 16 37	23	46
15	2 29 26	24	2 53 14	24	3 17 0	24	45
16	2 29 50	24	2 53 38	24	3 17 24	24	44
17	9 30 14	23	2 54 2	24	3 17 48	24	43
18	2 30 37	24	2 54 26	24	3 18 12	23	42
19	2 31 1	24	2 54 50	23	3 18 35	24	41
20	2 31 25	24	2 55 13	24	3 18 59	24	40
21	2 31 49	24	2 55 37	24	3 19 23	23	39
22	2 32 13	23	2 56 1	24	3 19 46	24	38
23	2 32 36	24	2 56 25	23	3 20 10	24	37
24	2 33 0	24	2 56 48	24	3 20 34	24	36
25	2 33 24	24	2 57 12	24	3 20 58	23	35
26	2 33 48	24	2 57 36	24	3 21 21	24	34
27	2 34 12	24	2 58 0	24	3 21 45	24	33
28	2 34 36	23	2 58 24	23	3 22 9	24	32
29	2 34 59	24	2 58 47	24	3 22 33	23	31
30	2 35 23	24	2 59 11	24	3 22 56	24	30
	23		22		21		

	6 Deg.			dif.	7 Deg.			dif	8 Deg.			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se	De.	Min.	Se.	Se	mi.
30	2	35	23	24	2	59	11	24	3	22	56	24	30
31	2	35	47	24	2	59	35	24	3	23	20	24	29
32	2	36	11	24	2	59	59	23	3	23	44	23	28
33	2	36	35	24	3	0	22	24	3	24	7	24	27
34	2	36	59	23	3	0	46	24	3	24	31	24	26
35	2	37	22	24	3	1	10	24	3	24	55	24	25
36	2	37	46	24	3	1	34	24	3	25	19	23	24
37	2	38	10	24	3	1	58	23	3	25	42	24	23
38	2	38	34	24	3	2	21	24	3	26	6	24	22
39	2	38	58	23	3	2	45	24	3	26	30	24	21
40	2	39	21	24	3	3	9	24	3	26	54	23	20
41	2	39	45	24	3	3	33	23	3	27	17	24	19
42	2	40	9	24	3	3	56	24	3	27	41	24	18
43	2	40	33	24	2	4	20	24	3	28	5	23	17
44	2	40	57	23	3	4	44	24	3	28	28	24	16
45	2	41	20	24	3	5	8	23	3	28	52	24	15
46	2	41	44	24	3	5	31	24	3	29	16	24	14
47	2	42	8	24	3	5	55	24	3	29	40	23	13
48	2	42	32	24	3	6	19	24	3	30	3	24	12
49	2	42	56	24	3	6	43	24	3	30	27	24	11
50	2	43	20	23	3	7	7	23	3	30	51	23	10
51	2	43	43	24	3	7	30	24	3	31	14	24	9
52	2	44	7	24	3	7	54	24	3	31	38	24	8
53	2	44	31	24	3	8	18	24	3	32	2	23	7
54	2	44	55	24	3	8	42	23	3	32	25	24	6
55	2	45	19	23	3	9	5	24	3	32	49	24	5
56	2	45	42	24	3	9	29	24	3	33	13	24	4
57	2	46	6	24	3	9	53	24	3	33	37	23	3
58	2	46	30	24	3	10	17	23	3	34	0	24	2
59	2	46	54	24	3	10	40	24	3	34	24	24	1
60	2	47	18	23	3	11	4	24	3	34	48	23	0
	23 Deg				22 Deg.				21 Deg.				

	9	dif.	10	dif.	11	dif.	
mi.	Deg. Mi. Se.	Se.	Deg. Mi. Se.	Se.	Deg. Mi. Se.	Se.	mi.
0	3 34 48	23	3 58 28	24	4 22 5	23	60
1	3 35 11	24	3 58 52	23	4 22 28	24	59
2	3 35 35	24	3 59 15	24	4 22 52	23	58
3	3 35 59	23	3 59 39	24	4 23 15	24	57
4	3 36 22	24	4 0 3	23	4 23 39	23	56
5	3 36 46	24	4 0 26	24	4 24 2	24	55
6	3 37 10	24	4 0 50	23	4 24 26	24	54
7	3 37 34	23	4 1 13	24	4 24 50	23	53
8	3 37 57	24	4 1 37	24	4 25 13	24	52
9	3 38 21	24	4 2 1	23	4 25 37	23	51
10	3 38 45	23	4 2 24	24	4 26 0	24	50
11	3 39 8	24	4 2 48	24	4 26 24	23	49
12	3 39 32	24	4 3 12	23	4 26 47	24	48
13	3 39 56	23	4 3 35	24	4 27 11	24	47
14	3 40 19	24	4 3 59	24	4 27 35	23	46
15	3 40 43	24	4 4 23	23	4 27 58	24	45
16	3 41 7	23	4 4 46	24	4 28 22	23	44
17	3 41 30	24	4 5 10	23	4 28 45	24	43
18	3 41 54	24	4 5 33	24	4 29 9	23	42
19	3 42 18	24	4 5 57	24	4 29 32	24	41
20	3 42 42	23	4 6 21	23	4 29 56	23	40
21	3 43 5	24	4 6 44	24	4 30 19	24	39
22	3 43 29	24	4 7 8	23	4 30 43	24	38
23	3 43 53	23	4 7 31	24	4 31 7	23	37
24	3 44 16	24	4 7 55	24	4 31 30	24	36
25	3 44 40	24	4 8 19	23	4 31 54	23	35
26	3 45 4	23	4 8 42	24	4 32 17	24	34
27	3 45 27	24	4 9 6	24	4 32 41	23	33
28	3 45 51	24	4 9 30	23	4 33 4	24	32
29	3 46 15	23	4 9 53	24	4 33 28	23	31
30	3 46 38	24	4 10 17	23	4 33 51	24	30
	20		19		18		

	9			dif.	10			dif.	11			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
30	3	46	38	24	4	10	17	23	4	33	51	24	30
31	3	47	2	24	4	10	40	24	4	34	15	24	29
32	3	47	26	23	4	11	4	24	4	34	39	23	28
33	3	47	49	24	4	11	28	23	4	35	2	24	27
34	3	48	13	24	4	11	51	24	4	35	26	23	26
35	3	48	37	23	4	12	15	23	4	35	49	24	25
36	3	49	0	24	4	12	38	24	4	36	13	23	24
37	3	49	24	24	4	13	2	24	4	36	36	24	23
38	3	49	48	23	4	13	26	23	4	37	0	23	22
39	3	50	11	24	4	13	49	24	4	37	23	24	21
40	3	50	35	24	4	14	13	23	4	37	47	23	20
41	3	50	59	23	4	14	36	24	4	38	10	24	19
42	3	51	22	24	4	15	0	24	4	38	34	23	18
43	3	51	46	24	4	15	24	23	4	38	57	24	17
44	3	52	10	23	4	16	47	24	4	39	21	23	16
45	3	52	33	24	4	16	11	23	4	39	44	24	15
46	3	52	57	24	4	16	34	24	4	40	8	23	14
47	3	53	21	23	4	16	58	24	4	40	31	24	13
48	3	53	44	24	4	17	22	23	4	40	55	24	12
49	3	54	8	24	4	17	45	24	4	41	19	23	11
50	3	54	32	23	4	18	9	23	4	41	42	24	10
51	3	54	55	24	4	18	32	24	4	42	6	23	9
52	3	55	19	23	4	18	56	24	4	42	29	24	8
53	3	55	42	24	4	19	20	23	4	42	53	23	7
54	3	56	6	24	4	19	43	24	4	43	16	24	6
55	3	56	30	23	4	20	7	23	4	43	40	23	5
56	3	56	53	24	4	20	30	24	4	44	3	24	4
57	3	57	17	24	4	20	54	23	4	44	27	23	3
58	3	57	41	23	4	21	17	24	4	44	50	24	2
59	3	58	4	24	4	21	41	24	4	45	14	23	1
60	3	58	28	24	4	22	5	23	4	45	37	23	0
		20				19				18			

	12			dif.	13			dif.	14			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
0	4	45	37	23	5	9	5	24	5	32	29	23	60
1	4	46	0	24	5	9	29	23	5	32	52	23	59
2	4	46	24	24	5	9	52	24	5	33	15	24	58
3	4	46	48	23	5	10	16	23	5	33	39	23	57
4	4	47	11	24	5	10	39	23	5	34	2	23	56
5	4	47	35	23	5	11	2	24	5	34	25	24	55
6	4	47	58	24	5	11	26	23	5	34	49	23	54
7	4	48	22	23	5	11	49	24	5	35	12	23	53
8	4	48	45	24	5	12	13	23	5	35	35	24	52
9	4	49	9	23	5	12	36	24	5	35	59	23	51
10	4	49	32	24	5	13	0	23	5	36	22	23	50
11	4	49	56	23	5	13	23	23	5	36	45	24	49
12	4	50	19	24	5	13	46	24	5	37	9	23	48
13	4	50	43	23	5	14	10	23	5	37	32	23	47
14	4	51	6	24	5	14	33	23	5	37	55	24	46
15	4	51	30	23	5	14	56	24	5	38	19	23	45
16	4	51	53	24	5	15	20	23	5	38	42	23	44
17	4	52	17	23	5	15	43	24	5	39	5	24	43
18	4	52	40	24	5	16	7	23	5	39	29	23	42
19	4	53	4	23	5	16	30	23	5	39	52	23	41
20	4	53	27	24	5	16	53	24	5	40	15	24	40
21	4	53	51	23	5	17	17	23	5	40	39	23	39
22	4	54	14	24	5	17	40	24	5	41	2	23	38
23	4	54	38	23	5	18	4	23	5	41	25	24	37
24	4	55	1	23	5	18	27	23	5	41	49	23	36
25	4	55	24	24	5	18	50	24	5	42	12	23	35
26	4	55	48	23	5	19	14	23	5	42	35	23	34
27	4	56	11	24	5	19	37	24	5	42	58	24	33
28	4	56	35	23	5	20	1	23	5	43	22	23	32
29	4	56	58	24	5	20	24	24	5	43	45	23	31
30	4	57	22	23	5	20	48	23	5	44	8	24	30
		17				16				15			

	12			dif.	13			dif.	14			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
30	4	57	22	23	5	20	48	23	5	44	8	24	30
31	4	57	45	24	5	21	11	23	5	44	32	23	29
32	4	58	9	23	5	21	34	24	5	44	55	23	28
33	4	58	32	24	5	21	58	23	5	45	18	24	27
34	4	58	56	23	5	22	21	24	5	45	42	23	26
35	4	59	19	24	5	22	45	23	5	46	5	23	25
36	4	59	43	23	5	23	8	23	5	46	28	23	24
37	5	0	6	24	5	23	31	24	5	46	51	24	23
38	5	0	30	23	5	23	55	23	5	47	15	23	22
39	5	0	53	23	5	24	18	23	5	47	38	23	21
40	5	1	16	24	5	24	41	24	5	48	1	24	20
41	5	1	40	23	5	25	5	23	5	48	25	23	19
42	5	2	3	24	5	25	28	23	5	48	48	23	18
43	5	2	27	23	5	25	51	24	5	49	11	23	17
44	5	2	50	24	5	26	15	23	5	49	34	24	16
45	5	3	14	23	5	26	38	24	5	49	58	23	15
46	5	3	37	24	5	27	2	23	5	50	21	23	14
47	5	4	1	23	5	27	25	23	5	50	44	24	13
48	5	4	24	23	5	27	48	24	5	51	8	23	12
49	5	4	47	24	5	28	12	23	5	51	31	23	11
50	5	5	11	23	5	28	35	23	5	51	54	23	10
51	5	5	34	24	5	28	58	24	5	52	17	24	9
52	5	5	58	23	5	29	22	23	5	52	41	23	8
53	5	6	21	24	5	29	45	24	5	53	4	23	7
54	5	6	45	23	5	30	9	23	5	53	27	23	6
55	5	7	8	24	5	30	32	23	5	53	50	24	5
56	5	7	32	23	5	30	55	24	5	54	14	23	4
57	5	7	55	23	5	31	19	23	5	54	37	23	3
58	5	8	18	24	5	31	42	23	5	55	0	24	2
59	5	8	42	23	5	32	5	24	5	55	24	23	1
60	5	9	5	24	5	32	29	23	5	55	47	23	0
		17				16				15			

	15			dif.	16			dif.	17			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
0	5	55	47	23	6	18	59	24	6	42	6	23	60
1	5	56	10	23	6	19	23	23	6	42	29	23	59
2	5	56	33	23	6	19	46	23	6	42	52	23	58
3	5	56	56	24	6	20	9	23	6	43	15	23	57
4	5	57	20	23	6	20	32	23	6	43	38	23	56
5	5	57	43	23	6	20	55	23	6	44	1	23	55
6	5	58	6	24	6	21	18	23	6	44	24	23	54
7	5	58	30	23	6	21	41	24	6	44	47	23	53
8	5	58	53	23	6	22	5	23	6	45	10	24	52
9	5	59	16	23	6	22	28	23	6	45	34	23	51
10	5	59	39	24	6	22	51	23	6	45	57	23	50
11	6	0	3	23	6	23	14	23	6	46	20	23	49
12	6	0	26	23	6	23	37	23	6	46	43	23	48
13	6	0	49	23	6	24	0	23	6	47	6	23	47
14	6	1	12	23	6	24	23	24	6	47	29	23	46
15	6	1	35	24	6	24	47	23	6	47	52	23	45
16	6	1	59	23	6	25	10	23	6	48	15	23	44
17	6	2	22	23	6	25	33	23	6	48	38	23	43
18	6	2	45	23	6	25	56	23	6	49	1	23	42
19	6	3	8	24	6	26	19	23	6	49	24	23	41
20	6	3	32	23	6	26	42	23	6	49	47	23	40
21	6	3	55	23	6	27	5	24	6	50	10	23	39
22	6	4	18	23	6	27	29	23	6	50	33	23	38
23	6	4	41	23	6	27	52	23	6	50	56	23	37
24	6	5	5	23	6	28	15	23	6	51	19	23	36
25	6	5	28	23	6	28	38	23	6	51	42	23	35
26	6	5	51	23	6	29	1	23	6	52	5	23	34
27	6	6	14	23	6	29	24	23	6	52	28	23	33
28	6	6	37	24	6	29	47	23	6	52	51	23	32
29	6	7	1	23	6	30	10	23	6	53	14	23	31
30	6	7	24	23	6	30	33	24	6	53	37	23	30
		14				13				12			

	15			dif.	16			dif.	17			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
30	6	7	24	23	6	30	33	24	6	53	37	23	30
31	6	7	47	23	6	30	57	23	6	54	0	23	29
32	6	8	10	23	6	31	20	23	6	54	23	23	28
33	6	8	33	24	6	31	43	23	6	54	46	23	27
34	6	8	57	23	6	32	6	23	6	55	9	23	26
35	6	9	20	23	6	32	29	23	6	55	32	23	25
36	6	9	43	23	6	32	52	23	6	55	35	23	24
37	6	10	6	23	6	33	15	23	6	56	18	23	23
38	6	10	29	24	6	33	38	23	6	56	41	23	22
39	6	10	53	23	6	34	1	24	6	57	4	23	21
40	6	11	16	23	6	34	25	23	6	57	27	23	20
41	6	11	39	23	6	34	48	23	6	57	50	23	19
42	6	12	2	23	6	35	11	23	6	58	13	23	18
43	6	12	25	24	6	35	34	23	6	58	36	23	17
44	6	12	49	23	6	35	57	23	6	58	59	23	16
45	6	13	12	23	6	36	20	23	6	59	22	23	15
46	6	13	15	23	6	36	43	23	6	59	45	23	14
47	6	13	58	23	6	37	6	23	7	0	8	23	13
48	6	14	21	24	6	37	29	23	7	0	31	23	12
49	6	14	45	23	6	37	52	23	7	0	54	23	11
50	6	15	8	23	6	38	15	23	7	1	17	23	10
51	6	15	31	23	6	38	38	24	7	1	40	23	9
52	6	15	54	23	6	39	2	23	7	2	3	23	8
53	6	16	17	23	6	39	25	23	7	2	26	23	7
54	6	16	40	24	6	39	48	23	7	2	49	23	6
55	6	17	4	23	6	40	11	23	7	3	12	23	5
56	6	17	27	23	6	40	34	23	7	3	35	23	4
57	6	17	50	23	6	40	57	23	7	3	58	23	3
58	6	18	13	23	6	41	20	23	7	4	21	23	2
59	6	18	36	23	6	41	43	23	7	4	44	22	1
60	6	18	59	24	6	42	6	23	7	5	6	23	0
		14				13				12			

	18			dif.	19			dif.	20			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se	Se.	mi.
0	7	5	6	23	7	28	0	23	7	50	47	23	60
1	7	5	29	23	7	28	23	23	7	51	10	22	59
2	7	5	52	23	7	28	46	23	7	51	32	23	58
3	7	6	15	23	7	29	9	23	7	51	55	23	57
4	7	6	38	23	7	29	32	22	7	52	18	22	56
5	7	7	1	23	7	29	54	23	7	52	40	23	55
6	7	7	24	22	7	30	17	23	7	53	3	23	54
7	7	8	47	23	7	30	40	23	7	53	26	23	53
8	7	8	10	23	7	31	3	23	7	53	49	22	52
9	7	8	33	23	7	31	26	22	7	54	11	23	51
10	7	8	56	23	7	31	48	23	7	54	34	23	50
11	7	9	19	23	7	32	11	23	7	54	57	22	49
12	7	9	42	23	7	32	34	23	7	55	19	23	48
13	7	10	5	23	7	32	57	23	7	55	42	23	47
14	7	10	28	23	7	33	20	23	7	56	5	22	46
15	7	10	51	22	7	33	43	22	7	56	27	23	45
16	7	11	13	23	7	34	5	23	7	56	50	23	44
17	7	11	36	23	7	34	28	23	7	57	13	22	43
18	7	11	59	23	7	34	51	23	7	57	35	23	42
19	7	12	22	23	7	35	14	23	7	57	58	23	41
20	7	12	45	23	7	35	37	22	7	58	21	22	40
21	7	13	8	23	7	35	59	23	7	58	43	23	39
22	7	13	31	23	7	36	22	23	7	59	6	23	38
23	7	13	54	23	7	36	45	23	7	59	29	22	37
24	7	14	17	23	7	37	8	23	7	59	51	23	36
25	7	14	40	23	7	37	31	22	8	0	14	23	35
26	7	15	3	22	7	37	53	23	8	0	37	22	34
27	7	15	25	23	7	38	16	23	8	0	59	23	33
28	7	15	48	23	7	38	39	23	8	1	22	23	32
29	7	16	11	23	7	39	2	22	8	2	45	23	31
30	7	16	34	23	7	39	24	23	8	2	8		30
		11				10				9			

	18			dif.	19			dif.	20			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se	Se.	Deg.	Mi.	Se.	Se.	mi.
30	7	16	34	23	7	39	24	23	8	2	8	23	30
31	7	16	57	23	7	39	47	23	8	2	31	23	29
32	7	17	20	23	7	40	10	23	8	2	54	22	28
33	7	17	43	23	7	40	33	23	8	3	16	23	27
34	7	18	6	23	7	40	56	22	8	3	39	23	26
35	7	18	29	23	7	41	18	23	8	4	2	22	25
36	7	18	52	22	7	41	41	23	8	4	24	23	24
37	7	19	14	23	7	42	4	23	8	4	47	22	23
38	7	19	37	23	7	42	27	22	8	5	9	22	22
39	7	20	0	23	7	42	49	23	8	5	31	23	21
40	7	20	23	23	7	43	12	23	8	5	54	23	20
41	7	20	46	23	7	43	35	23	8	6	17	22	19
42	7	21	9	23	7	43	58	22	8	6	39	23	18
43	7	21	32	23	7	44	20	23	8	7	2	22	17
44	7	21	55	22	7	44	43	23	8	7	24	23	16
45	7	22	17	23	7	45	6	23	8	7	47	23	15
46	7	22	40	23	7	45	29	22	8	8	10	22	14
47	7	23	3	23	7	45	51	23	8	8	32	23	13
48	7	23	26	23	7	46	14	23	8	8	55	23	12
49	7	23	49	23	7	46	37	23	8	9	18	22	11
50	7	24	12	23	7	47	0	22	8	9	40	23	10
51	7	24	35	22	7	47	22	23	8	10	3	22	9
52	7	24	57	23	7	47	45	23	8	10	25	23	8
53	7	25	20	23	7	48	8	23	8	10	48	23	7
54	7	25	43	24	7	48	31	22	8	11	11	22	6
55	7	26	6	23	7	48	53	23	8	11	33	23	5
56	7	26	29	23	7	49	16	23	8	11	56	22	4
57	7	26	52	23	7	49	39	22	8	12	18	23	3
58	7	27	15	22	7	50	1	23	8	12	41	23	2
59	7	27	37	23	7	50	24	23	8	13	4	22	1
60	7	28	0	23	7	50	47	23	8	13	36	23	0
		11				10				9			

	21	dif.	22	dif.	23	dif.	
mi.	Deg. Mi. Se.	Se.	Deg. Mi. Se.	Se.	Deg. Mi. Se.	Se.	mi.
0	8 13 26	23	8 35 58	22	8 58 21	22	60
1	8 13 49	22	8 36 20	23	8 58 43	23	59
2	8 14 11	23	8 36 43	22	8 59 6	22	58
3	8 14 34	22	8 37 5	22	8 59 28	22	57
4	8 14 56	23	8 37 27	23	8 59 50	22	56
5	8 15 19	23	8 37 50	22	9 0 12	23	55
6	8 15 42	22	8 38 12	23	9 0 35	22	54
7	8 16 4	23	8 38 35	22	9 0 57	22	53
8	8 16 27	22	8 38 57	23	9 1 19	23	52
9	8 16 49	23	8 39 20	22	9 1 42	22	51
10	8 17 12	23	8 39 42	23	9 2 4	22	50
11	8 75 35	22	8 40 5	22	9 2 26	33	49
12	8 17 57	23	8 40 27	22	9 2 49	22	48
13	8 18 20	22	8 40 49	23	9 3 11	22	47
14	8 18 42	23	8 41 12	22	9 3 33	22	46
15	8 19 5	22	8 41 34	23	9 3 55	23	45
16	8 19 27	23	8 41 57	22	9 4 18	22	44
17	8 19 50	22	8 42 19	22	9 4 40	22	43
18	8 20 12	23	8 42 41	23	9 5 2	23	42
19	8 20 35	23	8 43 4	22	9 5 25	22	41
20	8 20 58	22	8 43 26	23	9 5 47	22	40
21	8 21 20	23	8 43 49	22	9 6 9	22	39
22	8 21 43	22	8 44 11	23	9 6 31	23	38
23	8 22 5	23	8 44 34	22	9 6 54	22	37
24	8 22 28	22	8 44 56	22	9 7 16	22	36
25	8 22 50	23	8 45 18	23	9 7 38	22	35
26	8 23 13	22	8 45 41	22	9 8 0	23	34
27	8 23 35	23	8 46 3	23	9 8 23	22	33
28	8 23 58	22	8 46 26	22	9 8 45	22	32
29	8 24 20	23	8 46 48	22	9 9 7	22	31
20	8 24 43	22	8 47 10	23	9 9 29	23	30
	8		7		6		

	21			dif.	22			dif.	23			dif.	
mi.	*Deg.*	*Mi.*	*Se.*	*Se.*	*Deg.*	*Mi.*	*Se.*	*Se.*	*Deg.*	*Mi.*	*Se.*	*Se.*	*mi.*
30	8	24	43	22	8	47	10	23	9	9	29	23	30
31	8	25	5	23	8	47	33	22	9	9	52	22	29
32	8	25	28	22	8	47	55	22	9	10	14	22	28
33	8	25	50	23	8	48	17	23	9	10	36	22	27
34	8	26	13	22	8	48	40	22	9	10	58	23	26
35	8	26	35	23	8	49	2	23	9	11	21	22	25
36	8	26	58	23	8	49	25	22	9	11	43	22	24
37	8	27	21	22	8	49	47	22	9	12	5	22	23
38	8	27	43	23	8	50	9	23	9	12	27	23	22
39	8	28	6	22	8	50	32	22	9	12	50	22	21
40	8	28	28	23	8	50	54	22	9	13	12	22	20
41	8	28	51	22	8	51	16	23	9	13	34	22	19
42	8	29	13	23	8	51	39	22	9	13	56	22	18
43	8	29	36	22	8	52	1	23	9	14	18	23	17
44	8	29	58	23	8	52	24	22	9	14	41	22	16
45	8	30	21	22	8	52	46	22	9	15	3	22	15
46	8	30	43	22	8	53	8	23	9	15	25	22	14
47	8	31	5	23	8	53	31	22	9	15	47	22	13
48	8	31	28	22	8	53	53	22	9	16	9	23	12
49	8	31	50	23	8	54	15	23	9	16	32	22	11
50	8	32	13	22	8	54	38	22	9	16	54	22	10
51	8	32	35	23	8	55	0	22	9	17	16	22	9
52	8	32	58	22	8	55	22	23	9	17	38	22	8
53	8	33	20	23	8	55	45	22	9	18	0	23	7
54	8	33	43	22	8	56	7	22	9	18	23	22	6
55	8	34	5	23	8	56	29	22	9	18	45	22	5
56	8	34	28	22	8	56	51	23	9	19	7	22	4
57	8	34	50	23	8	57	14	22	9	19	29	22	3
58	8	35	13	22	8	57	36	23	9	19	51	23	2
59	8	35	35	23	8	57	59	22	9	20	14	22	1
60	8	35	58	22	8	58	21	22	9	20	36	22	0
		8				7				6			

	24			dif.	25			dif.	26			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se	Deg.	Mi	Se.	Se	mi.
0	9	20	36	22	9	42	42	22	10	4	38	22	60
1	9	20	58	22	9	43	4	22	10	5	0	22	59
2	9	21	20	22	9	43	26	22	10	5	22	22	58
3	9	21	42	22	9	43	48	22	10	5	44	21	57
4	9	22	4	23	9	44	10	22	10	6	5	22	56
5	9	22	27	22	9	44	32	22	10	6	27	22	55
6	9	22	49	22	9	44	54	22	10	6	49	22	54
7	9	23	11	22	9	45	16	22	10	7	11	22	53
8	9	23	33	22	9	45	38	22	10	7	33	22	52
9	9	23	55	22	9	46	0	22	10	7	55	22	51
10	9	24	17	22	9	46	22	22	10	8	17	21	50
11	9	24	39	23	9	46	44	22	10	8	38	22	49
12	9	25	2	22	9	47	6	22	10	9	0	22	48
13	9	25	24	22	9	47	28	22	10	9	22	22	47
14	9	25	46	22	9	47	50	22	10	9	44	22	46
15	9	26	8	22	9	48	12	22	10	10	6	21	45
16	9	26	30	22	9	48	34	22	10	10	27	22	44
17	9	26	52	22	9	48	56	21	10	10	49	22	43
18	9	27	14	23	9	49	17	22	10	11	11	22	42
19	9	27	37	22	9	49	39	22	10	11	33	22	41
20	9	27	59	22	9	50	1	22	10	11	55	22	40
21	9	28	21	22	9	50	23	22	10	12	17	21	39
22	9	28	43	22	9	50	45	22	10	12	38	22	38
23	9	29	5	23	9	51	7	22	10	13	0	22	37
24	9	29	27	22	9	51	29	22	10	13	22	22	36
25	9	29	49	22	9	51	51	22	10	13	44	22	35
26	9	30	11	22	9	52	13	22	10	14	6	21	34
27	9	30	33	23	9	52	35	22	10	14	27	22	33
28	9	30	56	22	9	52	57	22	10	14	49	22	32
29	9	31	18	22	9	53	19	22	10	15	11	22	31
30	9	31	40	22	9	53	41	22	10	15	33	21	30
		5				4				3			

mi.	24 Deg. Mi. Se.	dif. Se.	25 Deg. Mi. Se.	dif. Se.	26 Deg. Mi. Se.	dif. Se.	mi.
30	9 31 40	22	9 53 41	22	10 15 33	21	30
31	9 32 2	22	9 54 3	22	10 15 54	22	29
32	9 32 24	22	9 54 25	22	10 16 16	22	28
33	9 32 46	22	9 54 47	22	10 16 38	22	27
34	9 33 8	22	9 55 9	22	10 17 0	22	26
35	9 33 30	22	9 55 31	22	10 17 22	21	25
36	9 33 52	22	9 55 53	22	10 17 43	22	24
37	9 34 14	22	9 56 15	21	10 18 5	22	23
38	9 34 36	23	9 56 36	22	10 18 27	22	22
39	9 34 59	22	9 56 58	22	10 18 49	21	21
40	9 35 21	22	9 57 20	22	10 19 10	22	20
41	9 35 43	22	9 57 42	22	10 19 32	22	19
42	9 36 5	22	9 58 4	22	10 19 54	22	18
43	9 36 27	22	9 58 26	22	10 20 16	21	17
44	9 36 49	22	9 58 48	22	10 20 37	22	16
45	9 37 11	22	9 59 10	22	10 20 59	22	15
46	9 37 33	22	9 59 32	22	10 21 21	22	14
47	9 37 55	22	9 50 54	22	10 21 43	21	13
48	9 38 17	22	10 0 16	21	10 22 4	22	12
49	9 38 39	22	10 0 37	22	10 22 26	22	11
50	9 39 1	22	10 0 59	22	10 22 48	21	10
51	9 39 23	22	10 1 21	22	10 23 9	22	9
52	9 39 45	22	10 1 43	22	10 23 31	22	8
53	9 40 7	22	10 2 5	22	10 23 53	22	7
54	9 40 29	22	10 2 27	22	10 24 15	21	6
55	9 40 41	22	10 2 49	22	10 24 36	22	5
56	9 41 13	22	10 3 11	21	10 24 58	22	4
57	9 41 35	22	10 3 32	22	10 25 20	21	3
58	9 31 57	22	10 3 54	22	10 25 41	22	2
59	9 42 19	23	10 4 16	22	10 26 3	22	1
60	9 42 42	22	10 4 38	22	10 26 25	22	0
	5		4		3		

	27			dif.	28			dif.	29			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
0	10	26	25	22	10	48	2	21	11	9	28	21	60
1	10	26	47	21	10	48	23	22	11	9	49	22	59
2	10	27	8	22	10	48	45	21	11	10	11	21	58
3	10	27	30	22	10	49	6	22	11	10	32	21	57
4	10	27	52	21	10	49	28	21	11	10	53	22	56
5	10	28	13	22	10	49	49	22	11	11	15	21	55
6	10	28	35	22	10	50	11	21	11	11	36	21	54
7	10	28	57	21	10	50	32	22	11	11	57	22	53
8	10	29	18	22	10	50	54	21	11	12	19	21	52
9	10	29	40	22	10	51	15	22	11	12	40	21	51
10	10	30	2	21	10	51	37	21	11	13	1	22	50
11	10	30	23	22	10	51	58	22	11	13	23	21	49
12	10	30	45	22	10	52	20	21	11	13	44	21	48
13	10	31	7	21	10	52	41	22	11	14	5	22	47
14	10	31	28	22	10	53	3	21	11	14	27	21	46
15	10	31	50	22	10	53	24	22	11	14	48	21	45
16	10	32	12	21	10	53	46	21	11	15	9	22	44
17	10	32	33	22	10	54	7	22	11	15	31	21	43
18	10	32	55	22	10	54	29	21	11	15	52	21	42
19	10	33	17	21	10	54	50	22	11	16	13	21	41
20	10	33	38	22	10	55	12	21	11	16	34	22	49
21	10	34	0	22	10	55	33	22	11	16	56	21	39
22	10	34	22	21	10	55	55	21	11	17	17	21	38
23	10	34	43	22	10	56	16	21	11	17	38	22	37
24	10	35	5	21	10	56	37	22	11	18	0	21	36
25	10	35	26	22	10	56	59	21	11	18	21	21	35
26	10	35	40	22	10	57	20	22	11	18	42	21	34
27	10	36	10	21	10	57	42	21	11	19	3	22	33
28	10	36	31	22	10	58	3	22	11	19	25	21	32
29	10	36	53	22	10	58	25	21	11	19	46	21	31
30	10	37	15	21	10	58	46	22	11	20	7	21	30
		2				1				0			

Virgo. Pisces.

	27			dif.	28			dif.	29			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
30	10	27	15	21	10	58	46	22	11	20	7	21	30
31	10	37	36	22	10	59	8	21	11	20	28	22	29
32	10	37	58	21	10	59	29	21	11	20	50	21	28
33	10	38	19	22	10	59	50	22	11	21	11	21	27
34	10	38	41	22	11	0	12	21	11	21	32	21	26
35	10	39	3	21	11	0	33	22	11	21	53	22	25
36	10	39	24	22	11	0	55	21	11	22	15	21	24
37	10	39	46	21	11	1	16	22	11	22	36	21	23
38	10	40	7	22	11	1	38	21	11	22	57	21	22
39	10	40	39	22	11	1	59	21	11	23	18	22	21
40	10	40	51	21	11	2	20	22	11	23	40	21	20
41	10	41	12	22	11	2	42	21	11	24	1	21	19
42	10	41	34	21	11	3	3	22	11	24	22	21	18
43	10	41	55	22	11	3	25	21	11	24	43	21	17
44	10	42	17	21	11	3	46	21	11	25	4	22	16
45	10	42	38	22	11	4	7	22	11	25	26	21	15
46	10	43	0	22	11	4	29	21	11	25	47	21	14
47	10	43	22	21	11	4	50	21	11	26	8	21	13
48	10	43	43	22	11	5	11	22	11	26	29	21	12
49	10	44	5	21	11	5	33	21	11	26	50	22	11
50	10	44	26	22	11	5	54	22	11	27	12	21	10
51	10	44	48	21	11	6	16	21	11	27	33	21	9
52	10	45	9	22	11	6	37	21	11	27	54	21	8
53	10	45	31	21	11	6	58	22	11	28	15	21	7
54	10	45	52	22	11	7	20	21	11	28	36	22	6
55	10	46	14	22	11	7	41	22	11	28	58	21	5
56	10	46	36	21	11	8	3	21	11	29	19	21	4
57	10	46	57	22	11	8	24	21	11	29	40	21	3
58	10	47	19	21	11	8	45	22	11	30	1	21	2
59	10	47	40	22	11	9	7	21	11	30	22	22	1
60	10	48	2	21	11	9	28	21	11	30	44	21	0
		2				1				0			

	0			dif.	1			dif.	2			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
0	11	30	44	21	11	51	48	21	12	12	41	20	60
1	11	31	5	21	11	52	9	21	12	13	1	21	59
2	11	31	26	21	11	52	30	21	12	13	22	21	58
3	11	31	47	21	11	52	51	21	12	13	43	21	57
4	11	32	8	21	11	53	12	21	12	14	4	20	56
5	11	32	29	21	11	53	33	21	12	14	24	21	55
6	11	32	50	22	11	53	54	21	12	14	45	21	54
7	11	33	12	21	11	54	15	21	12	15	6	21	53
8	11	33	33	21	11	54	36	20	12	15	27	20	52
9	11	33	54	21	11	54	56	21	12	15	47	21	51
10	11	34	15	21	11	55	17	21	12	16	8	21	50
11	11	34	36	21	11	55	38	21	12	16	29	21	49
12	11	34	57	21	11	55	59	21	12	16	50	20	48
13	11	35	18	22	11	56	20	21	12	17	10	21	47
14	11	35	40	21	11	56	41	21	12	17	31	21	46
15	11	36	1	21	11	57	2	21	12	17	52	21	45
16	11	36	22	21	11	57	23	21	12	18	13	20	44
17	11	36	43	21	11	57	44	21	12	18	33	21	43
18	11	37	4	21	11	58	5	21	12	18	54	21	42
19	11	37	25	21	11	58	26	21	12	19	15	20	41
20	11	37	46	21	11	58	47	21	12	19	35	21	40
21	11	38	7	21	11	59	8	21	12	19	56	21	39
22	11	38	28	21	11	59	29	20	12	20	17	21	38
23	11	38	49	22	11	59	49	21	12	20	38	20	37
24	11	39	11	21	12	0	10	21	12	20	58	21	36
25	11	39	32	21	12	0	31	21	12	21	19	21	35
26	11	39	53	21	12	0	52	21	12	21	40	20	34
27	11	40	14	21	12	1	13	21	12	22	0	21	33
28	11	40	35	21	12	1	34	21	12	22	21	21	32
29	11	40	56	21	12	1	55	21	12	22	42	20	31
30	11	41	17	21	12	2	16	21	12	23	2	21	30
		29				28				27			

	0			dif.	1			dif.	2			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
30	11	41	17	21	12	2	16	21	12	23	2	21	30
31	11	41	38	21	12	2	37	20	12	23	23	21	29
32	11	41	59	21	12	2	57	21	12	23	44	20	28
33	11	42	20	21	12	3	18	21	12	24	4	21	27
34	11	42	41	21	12	3	39	21	12	24	25	21	26
35	11	43	2	21	12	4	0	21	12	24	46	20	25
36	11	43	23	22	12	4	21	21	12	25	6	21	24
37	11	43	45	21	12	4	42	21	12	25	27	21	23
38	11	44	6	21	12	5	3	20	12	25	48	20	22
39	11	44	27	21	12	5	23	21	12	26	8	21	21
40	11	44	48	21	12	5	44	21	12	26	29	21	20
41	11	45	9	21	12	6	5	21	12	26	50	20	19
42	11	45	30	21	12	6	26	21	12	27	10	21	18
43	11	45	51	21	12	6	47	21	12	27	31	21	17
44	11	46	12	21	12	7	8	20	12	27	52	20	16
45	11	46	33	21	12	7	28	21	12	28	12	21	15
46	11	46	54	21	12	7	49	21	12	28	33	20	14
47	11	47	15	21	12	8	10	21	12	28	53	21	13
48	11	47	36	21	12	8	31	21	12	29	14	21	12
49	11	47	57	21	12	8	52	21	12	29	35	20	11
50	11	48	18	21	12	9	13	20	12	29	55	21	10
51	11	48	39	21	12	9	33	21	12	30	16	21	9
52	11	49	0	21	12	9	54	21	12	30	37	20	8
53	11	49	21	21	12	10	15	21	12	30	57	21	7
54	11	49	42	21	12	10	36	21	12	31	18	20	6
55	11	50	3	21	12	10	57	20	12	31	38	21	5
56	11	50	24	21	12	11	17	21	12	31	59	21	4
57	11	50	45	21	12	11	38	21	12	32	20	20	3
58	11	51	6	21	12	11	59	21	12	32	40	21	2
59	11	51	27	21	12	12	20	21	12	33	1	20	1
60	11	51	48	21	12	12	41	20	12	33	21	21	0
		29				28				27			

	3			dif.	4			dif.	5			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se	Se.	mi.
0	12	33	21	21	12	53	50	20	13	14	5	21	60
1	12	33	42	20	12	54	10	20	13	14	26	20	59
2	12	34	2	21	12	54	30	21	13	14	46	20	58
3	12	34	23	21	12	54	51	20	13	15	6	20	57
4	12	34	44	20	12	55	11	20	13	15	26	20	56
5	12	35	4	21	12	55	31	21	13	15	46	20	55
6	12	35	25	20	12	55	52	20	13	16	6	20	54
7	12	35	45	21	12	56	12	21	13	16	26	20	53
8	12	36	6	20	12	56	33	20	13	16	46	21	52
9	12	36	26	21	12	56	53	20	13	17	7	20	51
10	12	36	47	20	12	57	13	21	13	17	27	20	50
11	12	37	7	21	12	57	34	20	13	17	47	20	49
12	12	37	28	20	12	57	54	20	13	18	7	20	48
13	12	37	48	21	12	58	14	20	13	18	27	20	47
14	12	38	9	21	12	58	34	21	13	18	47	20	46
15	12	38	30	20	12	58	55	20	13	19	7	20	45
16	12	38	50	21	12	59	15	20	13	19	27	20	44
17	12	39	11	20	12	59	35	21	13	19	47	21	43
18	12	39	31	21	12	59	56	20	13	20	8	20	42
19	12	39	52	20	13	0	16	20	13	20	28	20	41
20	12	40	12	21	13	0	36	21	13	20	48	20	40
21	12	40	33	20	13	0	57	20	13	21	8	20	39
22	12	40	53	21	13	1	17	20	13	21	28	20	38
23	12	41	14	20	13	1	37	21	13	21	48	20	37
24	12	41	34	21	13	1	58	20	13	22	8	20	36
25	12	41	55	20	13	2	18	20	13	22	28	20	35
26	12	42	15	21	13	2	38	20	13	22	48	20	34
27	12	42	36	20	13	2	58	21	13	23	8	20	33
28	12	42	56	21	13	3	19	20	13	23	28	20	32
29	12	43	17	20	13	3	39	20	13	23	48	20	31
30	12	43	37	21	13	3	59	20	13	24	8	20	30
		26				25				24			

	3			def.	4			dif.	5			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
30	12	43	37	21	13	3	59	20	13	24	8	20	30
31	12	43	58	20	13	3	19	21	13	24	28	20	29
32	12	44	18	20	13	3	40	20	13	44	48	20	28
33	12	44	38	21	13	4	0	20	13	25	8	20	27
34	12	44	59	20	13	4	20	20	13	25	28	20	26
35	12	45	19	21	13	4	40	21	13	25	48	21	25
36	12	45	40	20	13	5	1	20	13	26	9	20	24
37	12	46	0	21	13	5	21	20	13	26	29	20	23
38	12	46	21	20	13	5	41	20	13	26	49	20	22
39	12	46	41	21	13	6	1	21	13	27	9	20	21
40	12	47	2	20	13	6	22	20	13	27	29	20	20
41	12	47	22	20	13	6	42	20	13	27	49	20	19
42	12	47	42	21	13	7	2	20	13	28	9	20	18
43	12	48	3	20	13	7	22	20	13	28	29	20	17
44	12	48	23	21	13	7	42	21	13	28	49	20	16
45	12	48	44	20	13	8	3	20	13	29	9	20	15
46	12	49	4	21	13	8	23	20	13	29	29	20	14
47	12	49	25	20	13	8	43	20	13	29	49	19	13
48	12	49	45	20	13	9	3	20	13	30	8	20	12
49	12	50	5	21	13	9	23	21	13	30	28	22	11
50	12	50	26	20	13	9	44	20	13	30	48	20	10
51	12	50	46	21	13	10	4	20	13	31	8	20	9
52	12	51	7	20	13	10	24	20	13	31	28	20	8
53	12	51	27	20	13	10	44	20	13	31	48	20	7
54	12	51	47	21	13	11	4	21	13	32	8	20	6
55	12	52	8	20	13	11	25	20	13	32	28	20	5
56	12	52	28	21	13	11	45	20	13	32	48	20	4
57	12	52	49	20	13	12	5	20	13	33	8	20	3
58	12	53	9	20	13	12	25	20	13	33	28	20	2
59	12	53	29	21	13	12	45	20	13	33	48	20	1
60	12	53	50	20	13	13	5	21	13	34	8	20	0
		26				25				24			

	6			dif.	7			dif.	8			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
0	13	34	8	20	13	53	57	20	14	13	32	20	60
1	13	34	28	20	13	54	17	19	14	13	52	19	59
2	13	24	48	20	13	54	36	20	14	14	11	20	58
3	13	35	8	20	13	54	56	20	14	14	31	19	57
4	13	35	28	20	13	55	16	19	14	14	50	20	56
5	13	35	48	19	13	55	35	20	14	15	10	19	55
6	13	36	7	20	13	55	55	20	14	55	29	19	54
7	13	36	27	20	13	56	15	20	14	15	48	20	53
8	13	36	47	20	13	56	35	19	14	16	8	19	52
9	13	37	7	20	13	56	54	20	14	16	27	20	51
10	13	37	27	20	13	57	14	20	14	16	47	19	50
11	13	37	47	20	13	57	34	19	14	17	6	20	49
12	13	38	7	20	13	57	53	20	14	17	26	19	48
13	13	38	27	20	13	58	13	19	14	17	45	19	47
14	13	38	47	19	13	58	32	20	14	18	4	20	46
15	13	39	6	20	13	58	52	20	14	18	24	19	45
16	13	39	26	20	13	59	12	19	14	18	43	20	44
17	13	39	46	20	13	59	31	20	14	19	3	19	43
18	13	40	6	20	13	59	51	20	14	19	22	19	42
19	13	40	26	20	14	0	11	19	14	19	41	20	41
20	13	40	46	20	14	0	30	20	14	20	1	19	40
21	13	41	6	20	14	0	50	20	14	20	20	20	39
22	13	41	26	20	14	1	10	19	14	20	40	19	38
23	13	41	46	19	14	1	29	20	14	20	59	19	37
24	13	42	5	20	14	1	49	19	14	21	18	20	36
25	13	42	25	20	14	2	8	20	14	21	38	19	35
26	13	42	45	20	14	2	28	20	14	21	57	19	34
27	13	43	5	20	14	2	48	19	14	22	16	20	33
28	13	43	25	19	14	3	7	20	14	22	36	19	32
29	13	43	44	20	14	3	27	19	14	22	55	20	31
30	13	44	4	20	14	3	46	20	14	23	15	19	30
		23				22				21			

	6			dif.	7			dif	8			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se	mi.
30	13	44	4	20	14	3	46	20	14	23	15	19	30
31	13	44	24	20	14	4	6	20	14	23	34	19	29
32	13	44	44	20	14	4	26	19	14	23	53	20	28
33	13	45	4	19	14	4	45	20	14	24	13	19	27
34	13	45	23	20	14	5	5	19	14	24	32	19	26
35	13	45	43	20	14	5	24	20	14	24	51	20	25
36	13	46	3	20	14	5	44	19	14	25	11	19	24
37	13	46	23	20	14	6	3	20	14	25	30	19	23
38	13	46	43	19	14	6	23	20	14	25	49	19	22
39	13	47	2	20	14	6	43	19	14	26	8	20	21
40	13	47	22	20	14	7	2	20	14	26	28	19	20
41	13	47	42	20	14	7	22	19	14	26	47	19	19
42	13	48	2	19	14	7	41	20	14	27	6	20	18
43	13	48	21	20	14	8	1	19	14	27	26	19	17
44	13	48	41	20	14	8	20	20	14	27	45	19	16
45	13	49	1	20	14	8	40	19	14	28	4	20	15
46	13	49	21	20	14	8	59	20	14	28	24	19	14
47	13	49	41	19	14	9	19	19	14	28	43	19	13
48	13	50	0	20	14	9	38	20	14	29	2	19	12
49	13	50	20	20	14	9	58	19	14	29	21	20	11
50	13	50	40	20	14	10	17	20	14	29	41	19	10
51	13	51	0	19	14	10	37	19	14	30	0	19	9
52	13	51	19	20	14	10	56	20	14	30	19	19	8
53	13	51	39	20	14	11	16	19	14	30	38	20	7
54	13	51	59	19	14	11	35	20	14	30	58	19	6
55	13	52	18	20	14	11	55	19	14	31	17	19	5
56	13	52	38	20	14	12	14	20	14	31	36	19	4
57	13	52	58	20	14	12	34	19	14	31	55	20	3
58	13	53	18	19	14	12	53	20	14	32	15	19	2
59	13	53	37	20	14	13	13	19	14	32	34	19	1
60	13	53	57	20	14	13	32	20	14	32	53	19	0
		22				22				21			

	9			dif.	10			dif.	11			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
0	14	32	53	19	14	51	59	19	15	10	51	19	60
1	14	33	12	20	14	52	18	19	15	11	10	18	59
2	14	33	32	19	14	52	37	19	15	11	28	19	58
3	14	33	51	19	14	52	56	19	15	11	47	19	57
4	14	34	10	19	14	53	15	19	15	12	6	18	56
5	14	34	29	19	14	53	34	19	15	12	24	19	55
6	14	34	48	20	14	53	53	19	15	12	43	19	54
7	14	35	8	19	14	54	12	19	15	13	2	19	53
8	14	35	27	19	14	54	31	19	15	13	21	18	52
9	14	35	46	19	14	54	50	19	15	13	39	19	51
10	14	36	5	19	14	55	9	19	15	13	58	19	50
11	14	36	24	20	14	55	28	19	15	14	17	18	49
12	14	36	44	19	14	55	47	19	15	14	35	19	48
13	14	37	3	19	14	56	6	19	15	14	54	19	47
14	14	37	22	19	14	56	25	19	15	15	13	19	46
15	14	37	41	19	14	56	44	19	15	15	31	19	45
16	14	38	0	19	14	57	3	19	15	15	50	19	44
17	14	38	19	20	14	57	22	18	15	16	9	18	43
18	14	38	39	19	14	57	40	19	15	16	27	19	42
19	14	38	58	19	14	57	59	19	15	16	46	19	41
20	14	39	17	19	14	58	18	19	15	17	5	18	40
21	14	39	36	19	14	58	37	19	15	17	23	19	39
22	14	39	55	19	14	58	56	19	15	17	42	18	38
23	14	40	14	19	14	59	15	19	15	18	0	99	37
24	14	40	33	20	14	59	34	19	15	18	19	19	36
25	14	40	53	19	14	59	53	19	15	18	38	18	35
26	14	41	12	19	15	0	12	18	15	18	56	19	34
27	14	41	31	19	15	0	30	19	15	19	15	19	33
28	14	41	50	19	15	0	49	19	15	19	34	18	32
29	14	42	9	19	15	1	8	19	15	19	52	19	31
30	14	42	28	19	15	1	27	19	15	20	11	18	30
		20				19				18			

	9			dif.	10			dif.	11			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
30	14	42	28	19	15	1	27	19	15	20	11	18	30
31	14	42	47	19	15	1	46	19	15	20	29	19	29
32	14	43	6	19	15	2	5	19	15	20	48	19	28
33	14	43	25	20	15	2	24	18	15	21	7	18	27
34	14	43	45	19	15	2	44	19	15	21	25	19	26
35	14	44	4	19	15	3	1	19	15	21	44	18	25
36	14	44	23	19	15	3	20	19	15	22	2	19	24
37	14	44	42	19	15	3	39	19	15	22	21	18	23
38	14	45	1	19	15	3	58	19	15	22	39	19	22
39	14	45	20	19	15	4	17	18	15	22	58	19	21
40	14	45	39	19	15	4	35	19	15	23	17	18	20
41	14	45	58	19	15	4	54	19	15	23	35	19	19
42	14	46	17	19	15	5	13	19	15	23	54	18	18
43	14	46	36	19	15	5	32	19	15	24	12	19	17
44	14	46	55	19	15	5	51	18	15	24	31	18	16
45	14	47	14	19	15	6	9	19	15	24	49	19	15
46	14	47	33	19	15	6	28	19	15	25	8	18	14
47	14	47	52	19	15	6	47	19	15	25	26	19	13
48	14	48	11	19	15	7	6	19	15	25	45	18	12
49	14	48	30	19	15	7	25	18	15	26	3	19	11
50	14	48	49	19	15	7	43	19	15	26	22	18	10
51	14	49	8	20	15	8	2	19	15	26	40	19	9
52	14	49	28	19	15	8	21	19	15	26	59	18	8
53	14	49	47	19	15	8	40	18	15	27	17	19	7
54	14	50	6	19	15	8	58	19	15	27	36	18	6
55	14	50	25	19	15	9	17	19	15	27	54	19	5
56	14	50	44	19	15	9	36	19	15	28	13	18	4
57	14	51	3	19	15	9	55	18	15	28	31	19	3
58	14	51	22	19	15	10	13	19	15	28	50	18	2
59	14	51	41	18	15	10	32	19	15	29	8	19	1
60	14	51	59	19	15	10	51	19	15	29	27	18	0
		20				19				18			

	12			dif.	13			dif.	14			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
0	15	29	27	18	15	47	47	18	16	5	51	18	60
1	15	29	45	19	15	48	5	18	16	6	9	18	59
2	15	30	4	18	15	48	23	18	16	6	27	18	58
3	15	30	22	19	15	48	41	19	16	6	45	18	57
4	15	30	41	18	15	49	0	18	16	7	3	18	56
5	15	30	59	18	15	49	18	18	16	7	21	19	55
6	15	31	17	19	15	49	36	18	16	7	38	18	54
7	15	31	36	18	15	45	54	18	16	7	56	18	53
8	15	31	54	19	15	50	12	19	16	8	14	18	52
9	15	32	13	18	15	50	31	18	16	8	32	18	51
10	15	32	31	19	15	50	49	18	16	8	50	18	50
11	15	32	50	18	15	51	7	18	16	9	8	18	49
12	15	33	8	18	15	51	25	18	16	9	26	18	48
13	15	33	26	19	15	51	43	18	16	9	44	17	47
14	15	33	45	18	15	52	1	18	16	10	1	18	46
15	15	34	3	19	15	52	19	19	16	10	19	18	45
16	15	34	22	18	15	52	38	18	16	10	37	18	44
17	15	34	40	18	15	52	56	18	16	10	55	18	43
18	15	34	48	19	15	53	14	18	16	11	13	18	42
19	15	35	17	18	15	53	32	18	16	11	31	18	41
20	15	35	35	19	15	53	50	18	16	11	49	17	40
21	15	35	54	18	15	54	8	18	16	12	6	18	39
22	15	36	12	18	15	54	26	18	16	12	24	18	38
23	15	36	30	19	15	54	44	18	16	12	42	18	37
24	15	36	49	18	15	55	2	19	16	13	0	18	36
25	15	37	7	18	15	55	21	18	16	13	18	18	35
26	15	37	25	19	15	55	39	18	16	13	36	17	34
27	15	37	44	18	15	55	57	18	16	13	53	18	33
28	15	38	2	18	15	56	15	18	16	14	11	18	32
29	15	38	20	19	15	56	33	18	16	14	29	18	31
30	15	38	39	18	15	56	51	18	16	14	47	18	30
		17				16				15			

	12 ☊			dif.	13 ☊			dif.	14 ☊			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
30	15	38	39	18	15	56	51	18	16	14	47	18	30
31	15	38	57	18	15	57	9	18	16	15	5	17	29
32	15	39	15	19	15	57	27	18	16	15	22	18	28
33	15	39	34	18	15	57	45	18	16	15	40	18	27
34	15	39	52	18	15	58	3	18	16	15	58	18	26
35	15	40	10	19	15	58	31	18	16	16	16	17	25
36	15	40	29	18	15	58	39	18	16	16	33	18	24
37	15	40	47	18	15	58	57	18	16	16	51	18	23
38	15	41	5	19	15	59	15	18	16	17	9	18	22
39	15	41	24	18	15	59	33	18	16	17	27	17	21
40	15	41	42	18	15	59	51	18	16	17	44	18	20
41	15	42	0	19	16	0	9	18	16	18	2	18	19
42	15	42	19	18	16	0	27	18	16	18	20	18	18
43	15	42	37	18	16	0	45	18	16	18	38	17	17
44	15	42	55	18	16	1	3	18	16	18	55	18	16
45	15	43	13	19	16	1	21	18	16	19	13	18	15
46	15	43	32	18	16	1	39	18	16	19	31	18	14
47	15	43	50	18	16	1	57	18	16	19	49	17	13
48	15	44	8	18	16	2	15	18	16	20	6	18	12
49	15	44	26	19	16	2	33	18	16	20	24	18	11
50	15	44	45	18	16	2	51	18	16	20	42	17	10
51	15	45	3	18	16	3	9	18	16	20	59	18	9
52	15	45	21	18	16	3	27	18	16	21	17	18	8
53	15	45	39	19	16	3	45	18	16	21	35	17	7
54	15	45	58	18	16	4	3	18	16	21	52	18	6
55	15	46	16	18	16	4	21	18	16	22	10	18	5
56	15	46	34	18	16	4	39	18	16	22	28	17	4
57	15	46	52	18	16	4	57	18	16	22	45	18	3
58	15	47	10	19	16	5	15	18	16	23	3	18	2
59	15	47	29	18	16	5	33	18	16	23	21	17	1
60	15	47	47	18	16	5	51	18	16	23	38	18	0
		17				16				15			

	15			dif.	16			dif.	17			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se	mi.
0	16	23	38	18	16	41	9	17	16	58	22	17	60
1	16	23	56	18	16	41	26	18	16	58	39	18	59
2	16	24	14	17	16	41	44	17	16	58	57	17	58
3	16	24	31	18	16	42	1	17	16	59	14	17	57
4	16	24	49	18	16	42	18	18	16	59	31	17	56
5	16	25	7	17	16	42	36	17	16	59	48	17	55
6	16	25	24	18	16	42	53	17	17	0	5	17	54
7	16	25	42	17	16	43	10	18	17	0	22	17	53
8	16	25	59	18	16	43	28	17	17	0	39	17	52
9	16	26	17	18	16	43	45	17	17	0	56	17	51
10	16	26	35	17	16	44	2	18	17	1	13	17	50
11	16	26	52	18	16	44	20	17	17	1	30	17	49
12	16	27	10	18	16	44	37	17	17	1	47	17	48
13	16	27	28	17	16	44	54	18	17	2	4	17	47
14	16	27	45	18	16	45	12	17	17	2	21	17	46
15	16	28	3	17	16	45	29	17	17	2	38	17	45
16	16	28	20	18	16	45	46	18	17	2	55	17	44
17	16	28	38	17	16	46	4	17	17	3	12	17	43
18	16	28	55	18	16	46	21	17	17	3	29	17	42
19	16	29	13	18	16	46	38	17	17	3	46	17	41
20	16	29	31	17	16	46	55	18	17	4	3	17	40
21	16	29	48	18	16	47	13	17	17	4	20	17	39
22	16	30	6	17	16	47	30	17	17	4	37	17	38
23	16	30	23	18	16	47	47	17	17	4	54	17	37
24	16	30	41	17	16	48	4	18	17	5	11	17	36
25	16	30	58	18	16	48	22	17	17	5	28	17	35
26	16	31	16	17	16	48	39	17	17	5	45	17	34
27	16	31	33	18	16	48	56	17	17	6	2	17	33
28	16	31	51	17	16	49	13	18	17	6	19	17	32
29	16	32	8	18	16	49	31	17	17	6	36	17	31
30	16	32	26	17	16	49	48	17	17	6	53	16	30
		14				13				12			

	15			dif.	16			dif.	17			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
30	16	32	26	17	16	49	48	17	17	6	53	16	30
31	16	32	43	18	16	50	5	17	17	7	9	17	29
32	16	33	1	17	16	50	22	18	17	7	26	17	28
33	16	33	18	18	16	50	40	17	17	7	43	17	27
34	16	33	36	17	16	50	57	17	17	8	0	17	26
35	16	33	53	18	16	51	14	17	17	8	17	17	25
36	16	34	11	17	16	51	31	17	17	8	34	17	24
37	16	34	24	18	16	51	48	18	17	8	51	17	23
38	16	34	46	17	16	52	6	17	17	9	8	17	22
39	16	35	3	18	16	52	23	17	17	9	25	17	21
40	16	35	21	17	16	52	40	17	17	9	42	16	20
41	16	35	38	18	16	52	57	17	17	9	58	17	19
42	16	35	56	17	16	53	14	17	17	10	15	17	18
43	16	36	13	18	16	53	31	18	17	10	32	17	17
44	16	36	31	17	16	53	49	17	17	10	49	17	16
45	16	36	48	18	16	54	6	17	17	11	6	17	15
46	16	37	6	17	16	54	23	17	17	11	23	17	14
47	16	37	23	17	16	54	40	17	17	11	40	16	13
48	16	37	40	18	16	54	57	17	17	11	56	17	12
49	16	37	58	17	16	55	14	17	17	12	13	17	11
50	16	38	15	18	16	55	31	18	17	12	30	17	10
51	16	38	33	17	16	55	49	17	17	12	47	17	9
52	16	38	50	17	16	56	6	17	17	13	4	17	8
53	16	39	7	18	16	56	23	17	17	13	21	16	7
54	16	39	25	17	16	56	40	17	17	13	37	17	6
55	16	39	42	18	16	56	57	17	17	13	54	17	5
56	16	40	0	17	16	57	14	17	17	14	11	17	4
57	16	40	17	17	16	57	31	17	17	14	28	17	3
58	16	40	34	18	16	57	48	17	17	14	45	16	2
59	16	40	52	17	16	58	5	17	17	15	1	17	1
60	16	41	9	17	16	58	22	17	17	15	18	17	0
		14				13				12			

	18			dif.	19			dif.	20			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
0	17	15	18	17	17	31	56	16	17	48	15	16	60
1	17	15	35	17	17	32	12	17	17	48	31	17	59
2	17	15	52	16	17	32	29	16	17	48	48	16	58
3	17	16	8	17	17	32	45	17	17	49	4	16	57
4	17	16	25	17	17	33	2	16	17	49	20	16	56
5	17	16	42	17	17	33	18	17	17	49	36	16	55
6	17	16	59	16	17	33	35	16	17	49	52	16	54
7	17	17	15	17	17	33	51	17	17	50	8	16	53
8	17	17	32	17	17	34	8	16	17	50	24	17	52
9	17	17	49	17	17	34	24	16	17	50	41	16	51
10	17	18	6	16	17	34	40	17	17	50	57	16	50
11	17	18	22	17	17	34	57	16	17	51	13	16	49
12	17	18	39	17	17	35	13	17	17	51	29	16	48
13	17	18	56	16	17	35	30	16	17	51	45	16	47
14	17	19	12	17	17	35	46	17	17	52	1	16	46
15	17	19	29	17	17	36	3	16	17	52	17	16	45
16	17	19	46	17	17	36	19	16	17	52	33	16	44
17	17	20	3	16	17	36	35	17	17	52	49	17	43
18	17	20	19	17	17	36	52	16	17	53	6	16	42
19	17	20	36	17	17	37	8	16	17	53	22	16	41
20	17	20	53	16	17	37	24	17	17	53	38	16	40
21	17	21	9	17	17	37	41	16	17	53	54	16	39
22	17	21	26	17	17	37	57	17	17	54	10	16	38
23	17	21	43	16	17	38	14	16	17	54	26	16	37
24	17	21	59	17	17	38	30	16	17	54	42	16	36
25	17	22	16	17	17	38	46	17	17	54	58	16	35
26	17	22	33	16	17	39	3	16	17	55	14	16	34
27	17	22	49	17	17	39	39	16	17	55	30	16	33
28	17	23	6	17	17	39	35	17	17	56	46	16	32
29	17	23	3	16	17	39	52	16	17	56	2	16	31
30	17	23	39	17	17	40	8	16	17	56	18	16	30
		11				10				9			

	18			dif.	19			dif.	20			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
30	17	23	39	17	17	40	8	16	17	56	18	16	30
31	17	23	56	17	17	40	24	17	17	56	34	16	29
32	17	24	13	16	17	40	41	16	17	56	50	16	28
33	17	24	29	17	17	40	57	16	17	57	6	16	27
34	17	24	46	16	17	41	13	16	17	57	22	16	26
35	17	25	2	17	17	41	29	17	17	57	38	16	25
36	17	25	19	17	17	41	46	16	17	57	54	16	24
37	17	25	36	16	17	42	2	16	17	58	10	16	23
38	17	25	52	17	17	42	18	17	17	58	26	16	22
39	17	26	9	16	17	42	35	16	17	58	42	16	21
40	17	26	25	17	17	42	51	16	17	58	58	16	20
41	17	26	42	17	17	43	7	16	17	59	14	16	19
42	17	26	59	16	17	43	23	17	17	59	30	16	18
43	17	27	15	17	17	43	40	16	17	59	46	16	17
44	17	27	32	16	17	43	56	16	18	0	2	16	16
45	17	27	48	17	17	44	12	16	18	0	18	16	15
46	17	28	5	16	17	44	28	17	18	0	34	16	14
47	17	28	21	17	17	44	45	16	18	0	50	15	13
48	17	28	38	16	17	45	1	16	18	1	5	16	12
49	17	28	54	17	17	45	17	16	18	1	21	16	11
50	17	29	11	16	17	45	33	17	18	1	37	16	10
51	17	29	27	17	17	45	50	16	18	1	53	16	9
52	17	29	44	16	17	46	6	16	18	2	9	16	8
53	17	30	0	17	17	46	22	16	18	2	25	16	7
54	17	30	17	16	17	46	38	16	18	2	41	16	6
55	17	30	33	17	17	46	54	17	18	2	57	16	5
56	17	30	50	16	17	47	11	16	18	3	13	15	4
57	17	31	6	17	17	47	27	16	18	3	28	16	3
58	17	31	23	16	17	47	43	16	18	3	44	16	2
59	17	31	39	17	17	47	59	16	18	4	0	16	1
60	17	31	56	16	17	48	15	16	18	4	16	16	0
		11				10				9			

	21			dif.	22			dif.	23			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se	Deg.	Mi.	Se.	Se.	mi.
0	18	4	16	16	18	19	58	15	18	35	20	15	60
1	18	4	32	16	18	20	13	16	18	35	35	15	59
2	18	4	48	16	18	20	29	15	18	35	50	15	58
3	18	5	4	15	18	20	44	16	18	36	5	16	57
4	18	5	19	16	18	21	0	15	18	36	21	15	56
5	18	5	35	16	18	21	15	16	18	36	36	15	55
6	18	5	51	16	18	21	31	15	18	36	51	15	54
7	18	6	7	16	18	21	46	16	18	37	6	15	53
8	18	6	23	15	18	22	2	15	18	37	21	15	52
9	18	6	38	16	18	22	17	16	18	37	36	16	51
10	18	6	54	16	18	22	33	15	18	37	52	15	50
11	18	7	10	16	18	22	48	16	18	38	7	15	49
12	18	7	26	16	18	23	4	15	18	38	22	15	48
13	18	7	42	15	18	23	19	16	18	38	37	15	47
14	18	7	57	16	18	23	35	15	18	38	52	15	46
15	18	8	13	16	18	23	50	15	18	39	7	15	45
16	18	8	29	16	18	24	5	16	18	39	22	16	44
17	18	8	45	15	18	24	21	15	18	39	38	15	43
18	18	9	0	16	18	24	36	16	18	39	53	15	42
19	18	9	16	16	18	24	52	15	18	40	8	15	41
20	18	9	32	16	18	25	7	16	18	40	23	15	40
21	18	9	48	15	18	25	23	15	18	40	38	15	39
22	18	10	3	16	18	25	38	15	18	40	53	15	38
23	18	10	19	16	18	25	53	16	18	41	8	15	37
24	18	10	35	16	18	26	9	15	18	41	25	15	36
25	18	10	51	15	18	26	24	16	18	41	38	15	35
26	18	11	6	16	18	26	50	15	18	41	53	15	34
27	18	11	22	16	18	26	55	15	18	42	8	15	33
28	18	11	38	16	18	27	10	16	18	42	23	15	32
29	18	11	54	15	18	27	26	15	18	42	38	16	31
30	18	12	9	16	18	27	41	16	18	42	54	15	30
		8				7				6			

	21			dif.	22			dif.	23			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
30	18	12	9	16	18	27	41	16	18	42	54	15	30
31	18	12	25	16	18	27	57	15	18	43	9	15	29
32	18	12	41	15	18	28	12	15	18	43	24	15	28
33	18	12	56	16	18	28	27	16	18	43	39	15	27
34	18	13	12	16	18	28	43	15	18	43	54	15	26
35	18	13	28	15	18	28	58	15	18	44	9	15	25
36	18	13	43	16	18	29	13	16	18	44	24	15	24
37	18	13	59	16	18	29	29	15	18	44	39	15	23
38	18	14	15	15	18	29	44	15	18	44	54	15	22
39	18	14	30	16	18	29	59	16	18	45	9	15	21
40	18	14	46	16	18	30	15	15	18	45	24	15	20
41	18	15	2	15	18	30	30	15	18	45	39	15	19
42	18	15	17	16	18	30	45	16	18	45	54	15	18
43	18	15	33	15	18	31	1	15	18	46	9	15	17
44	18	15	48	16	18	31	16	15	18	46	24	14	16
45	18	16	4	16	18	31	31	15	18	46	38	15	15
46	18	16	20	15	18	31	46	16	18	46	53	15	14
47	18	16	35	16	18	32	2	15	18	47	8	15	13
48	18	16	51	15	18	32	17	15	18	47	23	15	12
49	18	17	6	16	18	32	32	15	18	47	38	15	11
50	18	17	22	16	18	32	47	16	18	47	53	15	10
51	18	17	38	15	18	33	3	15	18	48	8	15	9
52	18	17	53	16	18	33	18	15	18	48	23	15	8
53	18	18	9	15	18	33	33	15	18	48	38	15	7
54	18	18	24	16	18	33	48	16	18	48	53	15	6
55	18	18	40	15	18	34	4	15	18	49	8	15	5
56	18	18	55	16	18	34	19	15	18	49	23	15	4
57	18	19	11	16	18	34	34	15	18	49	38	14	3
58	18	19	27	15	18	34	49	16	18	49	52	15	2
59	18	19	42	16	18	35	5	15	18	50	7	15	1
60	18	19	58	15	18	35	20	15	18	50	22	15	0
		8				7				6			

	24			dif.	25			dif.	26			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se	Deg.	Mi.	Se.	Se.	mi.
0	18	50	22	15	19	5	5	14	19	19	26	15	60
1	18	50	37	15	19	5	19	15	19	19	41	14	59
2	18	50	52	15	19	5	34	14	19	19	55	14	58
3	18	51	7	15	19	5	48	15	19	20	9	14	57
4	18	51	22	15	19	6	3	14	19	20	23	14	56
5	18	51	37	14	19	6	17	15	19	20	37	14	55
6	18	51	51	15	19	6	32	14	19	20	51	15	54
7	18	52	6	15	19	6	46	15	19	21	6	14	53
8	18	52	21	15	19	7	1	14	19	21	20	14	52
9	18	52	36	15	19	7	15	15	19	21	34	14	51
10	18	52	51	55	19	7	30	14	19	21	48	14	50
11	18	53	6	14	19	7	44	15	19	22	2	14	49
12	18	53	20	15	19	7	59	14	19	22	16	14	48
13	18	53	35	15	19	8	13	14	19	22	30	14	47
14	18	53	50	15	19	8	27	15	19	22	44	15	46
15	18	54	5	15	19	8	42	14	19	22	59	14	45
16	18	54	20	14	19	8	56	15	19	23	13	14	44
17	18	54	34	15	19	9	11	14	19	23	27	14	43
18	18	54	49	15	19	9	25	15	19	24	41	14	42
19	18	55	4	15	19	9	40	14	19	23	55	14	41
20	18	55	19	14	19	9	54	15	19	24	9	14	40
21	18	55	33	15	19	10	9	14	19	24	23	14	39
22	18	55	48	15	19	10	23	14	19	24	37	14	38
23	18	56	3	15	19	10	37	15	19	24	51	14	37
24	18	56	18	14	19	10	52	14	19	25	5	14	36
25	18	56	32	15	19	11	6	15	19	25	19	14	35
26	18	56	47	15	19	11	21	14	19	25	33	14	34
27	18	57	2	15	19	11	35	14	19	25	47	14	33
28	18	57	17	14	19	11	49	15	19	26	1	14	32
29	18	57	31	15	19	12	4	14	19	26	15	15	31
30	18	57	46	15	19	12	18	14	19	26	30	14	30
		5				4				3			

mi.	24 Deg. Mi. Se.	dif. Se.	25 Deg. Mi. Se.	dif. Se.	26 Deg. Mi. Se.	dif. Se.	mi.
30	18 57 46	15	19 12 18	14	19 26 30	14	30
31	18 58 1	14	19 12 32	15	19 26 44	14	29
32	18 58 15	15	19 12 47	14	19 26 58	14	28
33	18 58 30	15	19 13 1	14	19 27 12	14	27
34	18 58 45	14	19 13 15	15	19 27 26	14	26
35	18 58 59	15	19 13 30	14	19 27 40	14	25
36	18 59 14	15	19 13 44	14	19 27 54	13	24
37	18 59 29	14	19 13 58	15	19 28 7	14	23
38	18 59 43	15	19 14 13	14	19 28 21	14	22
39	18 59 58	15	19 14 27	14	19 28 35	14	21
40	19 0 13	14	19 14 41	15	19 28 49	14	20
41	19 0 27	15	19 14 56	14	19 29 3	14	19
42	19 0 42	15	19 15 10	14	19 29 17	14	18
43	19 0 57	14	19 15 24	15	19 29 31	14	17
44	19 1 11	15	19 15 39	14	19 29 45	14	16
45	19 1 26	15	19 15 53	14	19 29 59	14	15
46	19 1 41	14	19 16 7	14	19 30 13	14	14
47	19 1 55	15	19 16 21	15	19 30 27	14	13
48	19 2 10	14	19 16 36	14	19 30 41	14	12
49	19 2 24	15	19 16 50	14	19 30 55	14	11
50	19 2 39	14	19 17 4	14	19 31 9	14	10
51	19 2 53	15	19 17 18	15	19 31 23	13	9
52	19 3 8	15	19 17 33	14	19 31 36	14	8
53	19 3 23	14	19 17 47	14	19 31 50	14	7
54	19 3 37	15	19 18 1	14	19 32 4	14	6
55	19 3 52	14	19 18 15	15	19 32 18	14	5
56	19 4 6	15	19 18 30	14	19 32 32	14	4
57	19 4 21	14	19 18 44	14	19 32 46	14	3
58	19 4 35	15	19 18 58	14	19 33 0	14	2
59	19 4 50	15	19 19 12	14	19 33 14	13	1
60	19 5 5	14	19 19 26	15	19 33 27	14	0
	5		4		3		

	27			dif.	28			dif.	29			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
0	19	33	27	14	19	47	7	14	20	0	26	13	60
1	19	33	41	14	19	47	21	13	20	0	39	13	59
2	19	33	55	14	19	47	34	14	20	0	52	13	58
3	19	34	9	14	19	47	48	13	20	1	5	13	57
4	19	34	23	14	19	48	1	14	20	1	18	13	56
5	19	34	37	13	19	48	15	13	20	1	31	13	55
6	19	34	50	14	19	48	28	14	20	1	44	14	54
7	19	35	4	14	19	48	42	13	20	1	58	13	53
8	19	35	18	14	19	48	55	13	20	2	11	13	52
9	19	35	32	14	19	49	8	14	20	2	24	13	51
10	19	35	46	13	19	49	22	13	20	2	37	13	50
11	19	35	59	14	19	49	35	14	20	2	50	13	49
12	19	36	13	14	19	49	49	13	20	3	3	13	48
13	19	36	27	14	19	50	2	14	20	3	16	13	47
14	19	36	41	13	19	50	16	13	20	3	29	13	46
15	19	36	54	14	19	50	29	13	20	3	42	13	45
16	19	37	8	14	19	50	42	14	20	3	55	13	44
17	19	37	22	14	19	50	56	13	20	4	8	13	43
18	19	37	36	13	19	51	9	14	20	4	21	13	42
19	19	37	49	14	19	51	23	13	20	4	34	13	41
20	19	38	3	14	19	51	36	13	20	4	47	13	40
21	19	38	17	14	19	51	49	14	20	5	0	13	39
22	19	38	31	13	19	52	3	13	20	5	13	13	38
23	19	38	44	14	19	52	16	13	20	5	26	13	37
24	19	38	58	14	19	52	29	14	20	5	39	13	36
25	19	39	12	13	19	52	43	13	20	5	52	13	35
26	19	39	25	14	19	52	56	13	20	6	5	13	34
27	19	39	39	14	19	53	9	14	20	6	18	13	33
28	19	39	53	13	19	53	23	13	20	6	31	13	32
29	19	40	6	14	19	53	36	13	20	6	44	13	31
30	19	40	20	14	19	53	49	14	20	6	57	13	30
		2				1				0			

	27			dif.	28			dif.	29			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
30	19	40	20	14	19	53	49	14	20	6	57	13	30
31	19	40	34	13	19	54	3	13	20	7	10	13	29
32	19	40	47	14	19	54	16	13	20	7	23	13	28
33	19	41	1	14	19	54	29	13	20	7	36	13	27
34	19	41	15	13	19	54	42	14	20	7	49	13	26
35	19	41	28	14	19	54	56	13	20	8	2	12	25
36	19	41	42	14	19	55	9	13	20	8	14	13	24
37	19	41	56	13	19	55	22	14	20	8	27	13	23
38	19	42	9	14	19	55	36	13	20	8	40	13	22
39	19	42	23	13	19	55	49	13	20	8	53	13	21
40	19	42	36	14	19	56	2	13	20	9	6	13	20
41	19	42	50	14	19	56	15	14	20	9	19	13	19
42	19	43	4	13	19	56	29	13	20	9	32	13	18
43	19	43	17	14	19	56	42	13	20	9	45	12	17
44	19	43	31	13	19	56	55	13	20	9	57	13	16
45	19	43	44	14	19	57	8	13	20	10	10	13	15
46	19	43	58	13	19	57	21	14	20	10	23	13	14
47	19	44	11	14	19	57	35	13	20	10	36	13	13
48	19	44	25	14	19	57	48	13	20	10	49	13	12
49	19	44	39	13	19	58	1	13	20	11	2	13	11
50	19	44	52	14	19	58	14	13	20	11	15	12	10
51	19	45	6	13	19	58	27	14	20	11	27	13	9
52	19	45	19	14	19	58	41	13	20	11	40	13	8
53	19	45	33	13	19	58	54	13	20	11	53	13	7
54	19	45	46	14	19	59	7	13	20	12	6	13	6
55	19	46	0	13	19	59	20	13	20	12	19	12	5
56	19	46	13	14	19	59	33	13	20	12	31	13	4
57	19	46	27	13	19	59	46	14	20	12	44	13	3
58	19	46	40	14	20	0	0	13	20	12	57	13	2
59	19	46	54	13	20	0	13	13	20	13	10	12	1
60	19	47	7	14	20	0	26	13	20	13	22	13	0
		I				I				0			

	0			dif.	1			dif.	2			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
0	20	13	22	13	20	25	57	12	20	38	9	12	60
1	20	13	35	13	20	26	9	13	20	38	21	12	59
2	20	13	48	13	20	26	22	12	20	38	33	12	58
3	20	14	1	12	20	26	34	13	20	38	45	12	57
4	20	14	13	13	20	26	47	12	20	38	57	12	56
5	20	14	26	13	20	26	59	12	20	39	9	12	55
6	20	14	39	13	20	27	11	13	20	39	21	12	54
7	20	14	52	12	20	27	24	12	20	39	33	12	53
8	20	15	4	13	20	27	36	12	20	39	45	12	52
9	20	15	17	13	20	27	48	13	20	39	57	12	51
10	20	15	30	12	20	28	1	12	20	40	9	12	50
11	20	15	42	13	20	28	13	12	20	40	21	12	49
12	20	15	55	13	20	28	25	13	20	40	33	12	48
13	20	16	8	13	20	28	38	12	20	40	45	12	47
14	20	16	21	12	20	28	50	12	20	40	57	12	46
15	20	16	33	13	20	29	2	12	20	41	9	12	45
16	20	16	46	13	20	29	14	13	20	41	21	11	44
17	20	16	59	12	20	29	27	12	20	41	32	12	43
18	20	17	11	13	20	29	39	12	20	41	48	12	42
19	20	17	24	12	20	29	51	13	20	41	56	12	41
20	20	17	36	13	20	30	4	12	20	42	8	12	40
21	20	17	49	13	20	30	16	12	20	42	20	12	39
22	20	18	2	12	20	30	28	12	20	42	32	12	38
23	20	18	14	13	20	30	40	13	20	42	44	12	37
24	20	18	27	13	20	30	53	12	20	42	56	12	36
25	20	18	40	12	20	31	5	12	20	43	8	13	35
26	20	18	52	13	20	31	17	12	20	43	19	12	34
27	20	19	5	12	20	31	29	12	20	43	31	12	33
28	20	19	17	13	20	31	41	13	20	43	43	12	32
29	20	19	30	13	20	31	54	12	20	43	55	12	31
30	20	19	43	12	20	32	6	12	20	44	7	12	30
		29				28				27			

Cancer. Capricorne.

	0			dif.	1			dif.	2			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se	Se.	Deg.	Mi.	Se.	Se.	mi.
30	20	19	43	12	20	32	6	12	20	44	7	12	30
31	20	19	55	13	20	32	18	12	20	44	19	11	29
32	20	20	8	12	20	32	30	12	20	44	30	12	28
33	20	20	20	13	20	32	42	13	20	44	42	12	27
34	20	20	33	12	20	32	55	12	20	44	54	12	26
35	20	20	45	13	20	33	7	12	20	45	6	12	25
36	20	20	58	12	20	33	19	12	20	45	18	11	24
37	20	21	10	13	20	33	31	12	20	45	29	12	23
38	20	21	23	12	20	33	43	12	20	45	41	12	22
39	20	21	35	13	20	33	55	13	20	45	53	12	21
40	20	21	48	12	20	34	8	12	20	46	5	11	20
41	20	22	0	13	20	34	20	12	20	46	16	12	19
42	20	22	13	12	20	34	32	12	20	46	28	12	18
43	20	22	25	13	20	34	44	12	20	46	40	12	17
44	20	22	38	12	20	34	56	12	20	46	52	11	16
45	20	22	50	13	20	35	8	12	20	47	3	12	15
46	20	23	3	12	20	35	2	12	20	47	15	12	14
47	20	23	15	13	20	35	32	13	20	47	27	12	13
48	20	23	28	12	20	35	45	12	20	47	39	11	12
49	20	24	40	13	20	35	57	12	20	47	50	12	11
50	20	24	53	12	20	36	9	12	20	48	2	12	10
51	20	24	5	13	20	36	21	12	20	48	14	11	9
52	20	24	18	12	20	36	33	12	20	48	25	12	8
53	20	24	30	13	20	36	45	12	20	48	37	12	7
54	20	24	43	12	20	36	57	12	20	48	49	11	6
55	20	24	55	12	20	37	9	12	20	49	0	12	5
56	20	25	7	13	20	37	21	12	20	49	12	12	4
57	20	25	20	12	20	37	33	12	20	49	24	11	3
58	20	25	32	13	20	37	45	12	20	49	35	12	2
59	20	25	45	12	20	37	57	12	20	49	47	12	1
60	20	25	57	12	20	38	9	12	20	49	59	11	0
		29				28				27			

mi.	3 Deg. Mi. Se.	dif. Se.	4 Deg. Mi. Se.	dif. Se.	5 Deg. Mi. Se.	dif. Se.	mi.
0	20 49 59	11	21 1 25	11	21 12 28	11	60
1	20 50 10	12	21 1 36	12	21 12 39	11	59
2	20 50 22	11	21 1 48	11	21 12 50	11	58
3	20 50 33	11	21 1 59	11	21 13 1	11	57
4	20 50 45	12	21 2 10	11	21 13 12	10	56
5	20 50 57	11	21 2 21	11	21 13 22	11	55
6	20 51 8	12	21 2 32	12	21 13 33	11	54
7	20 51 20	11	21 2 44	11	21 13 44	11	53
8	20 51 31	12	21 2 55	11	21 13 55	11	52
9	20 51 43	12	21 3 6	11	21 14 6	10	51
10	20 51 55	11	21 3 17	11	21 14 16	11	50
11	20 52 6	12	21 3 28	12	21 14 27	11	49
12	20 52 18	11	21 3 40	11	21 14 38	11	48
13	20 52 29	12	21 3 51	11	21 14 49	11	47
14	20 52 41	11	21 4 2	11	21 15 0	10	46
15	20 52 52	12	21 4 13	11	21 15 10	11	45
16	20 53 4	11	21 4 24	11	21 15 21	11	44
17	20 53 15	12	21 4 35	11	21 15 32	11	43
18	20 53 27	11	21 4 46	12	21 15 43	10	42
19	20 53 38	12	21 4 58	11	21 15 53	11	41
20	20 53 50	11	21 5 9	11	21 16 4	11	40
21	20 54 1	12	21 5 20	11	21 16 15	10	39
22	20 54 13	11	21 5 31	11	21 16 25	11	38
23	20 54 24	12	21 5 42	11	21 16 36	11	37
24	20 54 36	11	21 5 53	11	21 16 47	11	36
25	20 54 47	12	21 6 4	11	21 16 58	10	35
26	20 54 59	11	21 6 15	11	21 17 8	11	34
27	20 55 10	12	21 6 26	11	21 17 19	11	33
28	20 55 22	11	21 6 37	11	21 17 30	10	32
29	20 55 33	12	21 6 48	12	21 17 40	11	31
30	20 55 45	11	21 7 0	11	21 17 51	11	30
	26		25		24		

	3			dif.	4			dif.	5			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
30	20	55	45	11	21	7	0	11	21	17	51	11	30
31	20	55	56	12	21	7	11	11	21	18	2	10	29
32	20	56	8	11	21	7	22	11	21	18	12	11	28
33	20	56	19	11	21	7	33	11	21	18	23	10	27
34	20	56	30	12	21	7	44	11	21	18	33	11	26
35	20	56	42	11	21	7	55	11	21	18	44	11	25
36	20	56	53	12	21	8	6	11	21	18	55	10	24
37	20	57	5	11	21	8	17	11	21	19	5	11	23
38	20	57	16	11	21	8	28	11	21	19	16	11	22
39	20	57	27	12	21	8	39	11	21	19	27	10	21
40	20	57	39	11	21	8	50	11	21	19	37	11	20
41	20	57	50	12	21	9	1	11	21	19	48	10	19
42	20	58	2	11	21	9	12	11	21	19	58	11	18
43	20	58	13	11	21	9	23	11	21	20	9	11	17
44	20	58	24	12	21	9	34	11	21	20	20	10	16
45	20	58	36	11	21	9	45	11	21	20	30	11	15
46	20	58	47	11	21	9	56	11	21	20	41	10	14
47	20	58	58	12	21	10	7	10	21	20	51	11	13
48	20	59	10	11	21	10	17	11	21	21	2	10	12
49	20	59	21	11	21	10	28	11	21	21	12	11	11
50	20	59	32	12	21	10	39	11	21	21	23	10	10
51	20	59	44	11	21	10	50	11	21	21	33	11	9
52	20	59	55	11	21	11	1	11	21	21	44	10	8
53	21	0	6	11	21	11	12	11	21	21	54	11	7
54	21	0	17	12	21	11	23	11	21	22	5	10	6
55	21	0	29	11	21	11	34	11	21	22	15	11	5
56	21	0	40	11	21	11	45	11	21	22	26	10	4
57	21	0	51	12	21	11	56	10	21	22	36	11	3
58	21	1	3	11	21	12	6	11	21	22	47	10	2
59	21	1	14	11	21	12	17	11	21	22	57	11	1
60	21	1	25	11	21	12	28	11	21	23	8	10	0
		26				25				24			

	6			dif.	7			dif.	8			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
0	21	23	8	10	21	33	23	10	21	43	15	10	60
1	21	23	18	11	21	33	33	11	21	43	25	9	59
2	21	23	29	10	21	33	44	10	21	43	34	10	58
3	21	23	39	11	21	33	54	10	21	43	44	10	57
4	21	23	50	10	21	34	4	10	21	43	54	9	56
5	21	24	0	10	21	34	14	10	21	44	3	10	55
6	21	24	10	11	21	34	24	10	21	44	13	9	54
7	21	24	21	10	21	34	34	10	21	44	22	10	53
8	21	24	31	11	21	34	44	10	21	44	32	10	52
9	21	24	42	10	21	34	54	10	21	44	42	9	51
10	21	24	52	11	21	35	4	10	21	44	51	10	50
11	21	25	2	11	21	35	14	10	21	45	1	9	49
12	21	25	13	10	21	35	24	10	21	45	10	10	48
13	21	25	23	11	21	35	34	10	21	45	20	10	47
14	21	25	34	10	21	35	44	10	21	45	30	9	46
15	21	25	44	10	21	35	54	10	21	45	39	10	45
16	21	25	54	11	21	36	4	9	21	45	49	10	44
17	21	26	5	10	21	36	13	10	21	45	59	9	43
18	21	26	15	10	21	36	23	10	21	46	8	9	42
19	21	26	25	11	21	36	33	10	21	46	17	9	41
20	21	26	36	10	21	36	43	10	21	46	26	10	40
21	21	26	46	10	21	36	53	10	21	46	36	10	39
22	21	26	56	11	21	37	3	10	21	46	46	19	38
23	21	27	7	10	21	37	13	10	21	46	55	10	37
24	21	27	17	10	21	37	23	10	21	47	5	9	36
25	21	27	27	10	21	37	33	10	21	47	14	10	35
26	21	27	37	11	21	37	43	10	21	47	24	9	34
27	21	27	48	10	21	37	53	9	21	47	33	10	33
28	21	27	58	10	21	38	2	10	21	47	43	9	32
29	21	28	8	11	21	38	12	10	21	47	52	10	31
30	21	28	19	10	21	38	22	10	21	48	2	9	30
		23				22				21			

Cancer. Capricorne.

	6			dif.	7			dif.	8			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se	Se.	Deg.	Mi.	Se.	Se.	mi.
30	21	28	19	10	21	38	22	10	21	48	2	9	30
31	21	28	29	10	21	38	32	10	21	48	11	10	29
32	21	28	39	10	21	38	42	10	11	48	21	9	28
33	21	28	49	9	21	38	52	10	21	48	30	9	27
34	21	29	0	10	21	39	2	9	21	48	39	10	26
35	21	29	10	10	21	39	11	10	21	48	49	9	25
36	21	29	20	10	21	39	21	10	21	48	58	10	24
37	21	29	30	10	21	39	31	10	21	49	8	9	23
38	21	29	40	11	21	39	41	10	21	49	17	9	22
39	21	29	51	10	21	39	51	9	21	49	26	10	21
40	21	30	1	10	21	40	0	10	21	49	36	9	20
41	21	30	11	10	21	40	10	10	21	49	45	10	19
42	21	30	21	10	21	40	20	10	21	49	55	9	18
43	21	30	31	11	21	40	30	10	21	50	4	9	17
44	21	30	42	10	21	40	40	9	21	50	13	10	16
45	21	30	52	10	21	40	49	10	21	50	23	9	15
46	21	31	2	10	21	40	59	10	21	50	32	9	14
47	21	31	12	10	21	41	9	10	21	50	41	10	13
48	21	31	22	10	21	41	19	9	21	50	51	9	12
49	21	31	32	10	21	41	28	10	21	51	0	9	11
50	21	31	42	11	21	41	38	10	21	51	9	10	10
51	21	31	53	10	21	41	48	10	21	51	19	9	9
52	21	32	3	10	21	41	58	9	21	51	28	9	8
53	21	32	13	10	21	42	7	10	21	51	37	10	7
54	21	32	23	10	21	42	17	10	21	51	47	9	6
55	21	32	33	10	21	42	27	9	21	51	56	9	5
56	21	32	43	10	21	42	36	10	21	52	5	9	4
57	21	32	53	10	21	42	46	10	21	52	14	10	3
58	21	33	3	10	21	42	56	9	21	52	24	9	2
59	21	33	13	10	21	43	5	10	21	52	33	9	1
60	21	33	23	10	21	43	15	10	21	52	42	9	0
		23				22				21			

	9			dif.	10			dif.	11			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
0	21	52	42	9	22	1	45	9	22	10	22	9	60
1	21	52	51	10	22	1	54	8	22	10	31	8	59
2	21	53	1	9	22	2	2	9	22	10	39	9	58
3	21	53	10	9	22	2	11	9	22	10	48	8	57
4	21	53	19	9	22	2	20	9	22	10	56	8	56
5	21	53	28	10	22	2	29	9	22	11	4	9	55
6	21	53	38	9	22	2	38	8	22	11	13	8	54
7	21	53	47	9	22	2	46	9	22	11	21	9	53
8	21	53	56	9	22	2	55	9	22	11	30	8	52
9	21	54	5	9	22	3	4	9	22	11	38	8	51
10	21	54	14	10	22	3	13	9	22	11	46	9	50
11	21	54	24	9	22	3	22	8	22	11	55	8	49
12	21	54	33	9	22	3	30	9	22	12	3	8	48
13	21	54	42	9	22	3	39	9	22	12	11	9	47
14	21	54	51	9	22	3	48	9	22	12	20	8	46
15	21	55	0	9	22	3	57	8	22	12	28	8	45
16	21	55	9	9	22	4	5	9	22	12	36	9	44
17	21	55	18	10	22	4	14	9	22	12	45	8	43
18	21	55	28	9	22	4	23	8	22	12	53	8	42
19	21	55	37	9	22	4	31	9	22	13	1	8	41
20	21	55	46	9	22	4	40	9	22	13	9	9	40
21	21	55	55	9	22	4	49	9	22	13	18	8	39
22	21	56	4	9	22	4	58	8	22	13	26	8	38
23	21	56	13	9	22	5	6	9	22	13	34	9	37
24	21	56	22	9	22	5	15	9	22	13	43	8	36
25	21	56	31	9	22	5	24	8	22	13	51	8	35
26	21	56	40	9	22	5	32	9	22	13	59	8	34
27	21	56	49	9	22	5	41	8	22	14	7	8	33
28	21	56	58	10	22	5	49	9	22	14	15	9	32
29	21	57	8	9	22	5	58	9	22	14	24	8	31
30	21	57	17	9	22	6	7	8	22	14	32	8	30
		20				19				18			

	9			dif.	10			dif.	11			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
30	21	57	17	9	22	6	7	8	22	14	32	8	30
31	22	57	26	9	22	6	15	9	22	14	40	8	29
32	21	57	35	9	22	6	24	9	22	14	48	9	28
33	21	57	44	9	22	6	33	8	22	14	57	8	27
34	21	57	53	9	22	6	41	9	22	15	5	8	26
35	21	58	2	9	22	6	50	8	22	15	13	8	25
36	21	58	11	9	22	6	58	9	22	15	21	8	24
37	21	58	20	9	22	7	7	9	22	15	29	8	23
38	21	58	29	9	22	7	16	8	22	15	37	9	22
39	21	58	38	9	22	7	24	9	22	15	46	8	21
40	21	58	47	9	23	7	33	8	22	15	54	8	20
41	21	58	56	9	23	7	41	9	22	16	2	8	19
42	21	59	5	9	23	7	50	8	22	16	10	8	18
43	21	59	14	9	22	7	58	9	22	16	18	8	17
44	21	59	23	8	22	8	7	8	22	16	26	8	16
45	21	59	31	9	22	8	15	9	22	16	34	8	15
46	21	59	40	9	22	8	24	8	22	16	42	8	14
47	21	59	49	9	22	8	32	9	22	16	50	9	13
48	21	59	58	9	22	8	41	8	22	16	59	8	12
49	22	0	7	9	22	8	49	9	22	17	7	8	LI
50	22	0	16	9	22	8	58	8	22	17	15	8	10
51	22	0	25	9	22	9	6	9	22	17	23	8	9
52	21	0	34	9	22	9	15	8	22	17	31	8	8
53	21	0	43	9	22	9	23	9	22	17	39	8	7
54	21	0	52	9	22	9	32	8	22	17	47	8	6
55	21	1	1	8	22	9	40	9	22	17	55	8	5
56	21	1	9	9	22	9	49	8	22	18	3	8	4
57	21	1	18	9	22	9	57	9	22	18	11	8	3
58	22	1	27	9	22	10	6	8	22	18	19	8	2
59	22	1	36	9	22	10	14	8	22	18	27	8	1
60	22	1	45	9	22	10	22	9	22	18	35	8	0
		20				19				18			

Cancer. Capricorne.

	12			dif.	13			dif.	14			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
0	22	18	35	8	22	26	22	8	22	33	44	7	60
1	22	18	43	8	22	26	30	7	22	33	51	7	59
2	22	18	51	8	22	26	37	8	22	33	58	7	58
3	22	18	59	8	22	26	45	8	22	34	5	8	57
4	22	19	7	8	22	26	53	7	22	34	13	7	56
5	22	19	15	8	22	27	0	8	22	34	20	7	55
6	22	19	23	8	22	27	8	7	22	34	27	7	54
7	22	19	31	8	22	27	15	8	22	34	34	7	53
8	22	19	39	8	22	27	23	7	22	34	41	7	52
9	22	19	47	8	22	27	30	8	22	34	48	7	51
10	22	19	55	8	22	27	38	7	22	34	55	7	50
11	22	20	3	8	22	27	45	8	22	35	2	7	49
12	22	20	11	7	22	27	53	7	22	35	9	7	48
13	22	20	18	8	22	28	0	8	22	35	16	7	47
14	22	20	26	8	22	28	8	7	22	35	23	7	46
15	22	20	34	8	22	28	15	8	22	35	30	8	45
16	22	20	42	8	22	28	23	7	22	35	38	7	44
17	22	20	50	8	22	28	30	8	22	35	45	7	43
18	22	20	58	8	22	28	38	7	22	35	52	7	42
19	22	21	6	8	22	28	45	7	22	35	59	7	41
20	22	21	14	7	22	28	52	8	22	36	6	7	40
21	22	21	21	8	22	29	0	7	22	36	13	7	39
22	22	21	29	8	22	29	7	8	22	36	20	7	38
23	22	21	37	8	22	29	15	7	22	36	27	7	37
24	22	21	45	8	22	29	22	7	22	36	34	7	36
25	22	21	53	8	22	29	29	8	22	36	41	6	35
26	22	22	1	7	22	29	37	7	22	36	47	7	34
27	22	22	8	8	22	29	44	8	22	36	54	7	33
28	22	22	16	8	22	29	52	7	22	37	1	7	32
29	22	22	24	8	22	29	59	7	22	37	8	7	31
30	22	22	32	8	22	30	6	8	22	37	15	7	30
		17				16				15			

Cancer. Capricorne.

	12			dif.	13			dif.	14			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se	mi.
30	22	22	32	8	22	30	6	8	22	37	15	7	30
31	22	22	40	7	22	30	14	7	22	37	22	7	29
32	22	22	47	8	22	30	21	7	22	37	29	7	28
33	22	22	55	8	22	30	28	8	22	37	36	7	27
34	22	23	3	8	22	30	36	7	22	37	43	7	26
35	22	23	11	7	22	30	43	7	22	37	50	7	25
36	22	23	18	8	22	30	50	8	22	37	57	7	24
37	22	23	26	8	22	30	58	7	22	38	4	7	23
38	22	23	34	8	22	31	5	7	22	38	11	6	22
39	22	23	42	7	22	31	12	8	22	38	17	7	21
40	22	23	49	8	22	31	20	7	22	38	24	7	20
41	22	23	57	8	22	31	27	7	22	38	31	7	19
42	22	24	5	7	22	31	34	7	22	38	38	7	18
43	22	24	12	8	22	31	41	8	22	38	45	7	17
44	22	24	20	8	22	31	49	7	22	38	52	6	16
45	22	24	28	8	22	31	56	7	22	38	58	7	15
46	22	24	36	7	22	32	3	8	22	39	5	7	14
47	22	24	43	8	22	32	11	7	22	39	12	7	13
48	22	24	51	8	22	32	18	7	22	39	19	7	12
49	22	24	59	7	22	32	25	7	22	39	26	7	11
50	22	25	6	8	22	32	32	7	22	39	33	6	10
51	22	25	14	7	22	32	39	8	22	39	39	7	9
52	22	25	21	8	22	32	47	7	22	39	46	7	8
53	22	25	29	8	22	32	54	7	22	39	53	7	7
54	22	25	37	7	22	33	1	7	22	40	0	6	6
55	22	25	44	8	22	33	8	7	22	40	6	7	5
56	22	25	52	8	22	33	15	8	22	40	13	7	4
57	22	26	0	7	22	33	23	7	22	40	20	7	3
58	22	26	7	8	22	33	30	7	22	40	27	6	2
59	22	26	15	7	22	33	37	7	22	40	33	7	1
60	22	26	22	8	22	33	44	7	22	40	40	7	0
		17				16				15			

Cancer. Capricorne.

	15			dif.	16			dif.	17			dif.	
mi.	Deg.	Mi.	Se	Se.	Deg.	Mi.	Se	Se.	Deg.	Mi.	Se	Se.	mi.
0	22	40	40	7	22	47	10	6	22	53	14	6	60
1	22	40	47	6	22	47	16	7	22	53	20	6	59
2	22	40	53	7	22	47	23	6	22	53	26	6	58
3	22	41	0	7	22	47	29	6	22	53	32	5	57
4	22	41	7	7	22	47	35	6	22	53	37	6	56
5	22	41	14	6	22	47	41	7	22	53	43	6	55
6	22	41	20	7	22	47	48	6	22	53	49	6	54
7	22	41	27	7	22	47	54	6	22	53	55	6	53
8	22	41	34	6	22	48	0	6	22	54	1	5	52
9	22	41	40	7	22	48	6	7	22	54	6	6	51
10	22	41	47	7	22	48	13	6	22	54	12	6	50
11	22	41	54	6	22	48	19	6	22	54	18	6	49
12	22	42	0	7	22	48	25	6	22	54	24	5	48
13	22	42	7	6	22	48	31	6	22	54	29	6	47
14	22	42	13	7	22	48	37	7	22	54	35	6	46
15	22	42	20	7	22	48	44	6	22	54	41	6	45
16	22	42	27	6	22	48	50	6	22	54	47	5	44
17	22	42	33	7	22	48	56	6	22	54	52	6	43
18	22	42	40	6	22	49	2	6	22	54	58	6	42
19	22	42	46	7	22	49	8	6	22	55	4	6	41
20	22	42	53	7	22	49	14	6	22	55	10	5	40
21	22	43	0	6	22	49	20	7	22	55	15	6	39
22	22	43	6	7	22	49	27	6	22	55	21	6	38
23	22	43	13	6	22	49	33	6	22	55	27	5	37
24	22	43	19	7	22	49	39	6	22	55	32	6	36
25	22	43	26	6	22	49	45	6	22	55	38	6	35
26	22	43	32	7	22	49	51	6	22	55	44	5	34
27	22	43	39	6	22	49	57	6	22	55	49	6	33
28	22	43	45	7	22	50	3	6	22	55	55	6	32
29	22	43	52	6	22	50	9	6	22	56	1	5	31
30	22	43	58	7	22	50	15	6	22	56	6	6	30
		14				13				12			

	15			dif.	16			dif.	17			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
30	22	43	58	7	22	50	15	6	22	56	6	6	30
31	22	44	5	6	22	50	21	6	22	56	12	5	29
32	22	44	11	7	22	50	27	7	22	56	17	6	28
33	22	44	18	6	22	50	34	6	22	56	23	6	27
34	22	44	24	7	22	50	40	6	22	56	29	5	26
35	22	44	31	6	22	50	46	6	22	56	34	6	25
36	22	44	37	7	22	50	52	6	22	56	40	5	24
37	22	44	44	6	22	50	58	6	22	56	45	6	23
38	22	44	50	7	22	51	4	6	22	56	51	6	22
39	22	44	57	6	22	51	10	6	22	56	57	5	21
40	22	45	3	6	22	51	16	6	22	57	2	6	20
41	22	45	9	7	22	51	22	6	22	57	8	5	19
42	22	45	16	6	22	51	28	6	22	57	13	6	18
43	22	45	22	7	22	51	34	6	22	57	19	5	17
44	22	45	29	6	22	51	40	6	22	57	24	6	16
45	22	45	35	6	22	51	46	6	22	57	30	5	15
46	22	45	41	7	22	51	52	5	22	57	35	6	14
47	22	45	48	6	22	51	57	6	22	57	41	5	13
48	22	45	54	7	22	52	3	6	22	57	46	6	12
49	22	46	1	6	22	52	9	6	22	57	52	5	11
50	22	46	7	6	22	52	15	6	22	57	57	6	10
51	22	46	13	7	22	12	21	6	22	58	3	5	9
52	22	46	20	6	22	52	27	6	22	58	8	6	8
53	22	46	26	6	22	52	33	6	22	58	14	5	7
54	22	46	32	7	22	52	39	6	22	58	19	6	6
55	22	46	39	6	22	52	45	6	22	58	25	5	5
56	22	46	45	6	22	52	51	6	22	58	30	6	4
57	22	46	51	7	22	52	57	5	22	58	36	5	3
58	22	46	58	6	22	53	2	6	22	58	41	5	2
59	22	47	4	6	22	53	8	6	22	58	46	6	1
60	22	47	10	6	22	53	14	6	22	58	52	5	0
		14				13				12			

Cancer. Capricorne.

	18			dif.	19			d.f.	20			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
0	22	58	52	5	23	4	3	5	23	8	48	4	60
1	22	58	57	6	23	4	8	5	23	8	52	5	59
2	22	59	3	5	23	4	13	5	23	8	57	4	58
3	22	59	8	5	23	4	18	5	23	9	1	5	57
4	22	59	13	6	23	4	23	5	23	9	6	4	56
5	22	59	19	5	23	4	28	5	23	9	10	5	55
6	22	59	24	5	23	4	33	5	23	9	15	4	54
7	22	59	29	6	23	4	38	5	23	9	19	5	53
8	22	59	35	5	23	4	43	4	23	9	24	4	52
9	22	59	40	5	23	4	47	5	23	9	28	5	51
10	22	59	45	6	23	4	52	5	23	9	33	4	50
11	22	59	51	5	23	4	57	5	23	9	37	5	49
12	22	59	56	5	23	5	2	5	23	9	42	4	48
13	23	0	1	6	23	5	7	5	23	9	46	4	47
14	23	0	7	5	23	5	12	5	23	9	50	5	46
15	23	0	12	5	23	5	17	5	23	9	55	4	45
16	23	0	17	6	23	5	22	4	23	9	59	5	44
17	23	0	23	5	23	5	26	5	23	10	4	4	43
18	23	0	28	5	23	5	31	5	23	10	8	4	42
19	23	0	33	5	23	5	36	5	23	10	12	5	41
20	23	0	38	6	23	5	41	5	23	10	17	4	40
21	23	0	44	5	23	5	46	5	23	10	21	4	39
22	23	0	49	5	23	5	51	4	23	10	25	5	38
23	23	0	54	5	23	5	55	5	23	10	30	4	37
24	23	0	59	6	23	6	0	5	23	10	34	5	36
25	23	1	5	5	23	6	5	5	23	10	39	4	35
26	23	1	10	5	23	6	10	4	23	10	43	4	34
27	33	1	15	5	23	6	14	5	23	10	47	5	33
28	23	1	20	5	23	6	19	5	23	10	52	4	32
29	23	1	25	6	23	6	24	5	23	10	56	4	31
30	23	1	31		23	6	29		23	11	0		30
		11				10				9			

	18			dif.	19			dif.	20			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi	Se	Se.	Deg.	Mi.	Se.	Se.	mi.
30	23	1	31	5	23	6	29	4	23	11	0	4	30
31	23	1	36	5	23	6	33	5	23	11	4	5	29
32	23	1	41	5	23	6	38	5	23	11	9	4	28
33	23	1	46	5	23	6	43	5	23	11	13	4	27
34	23	1	51	6	23	6	48	4	23	11	17	5	26
35	23	1	57	5	23	6	52	5	23	11	22	4	25
36	23	2	2	5	23	6	57	5	23	11	26	4	24
37	23	2	7	5	23	7	2	4	23	11	30	4	23
38	23	2	12	5	23	7	6	5	23	11	34	5	22
39	23	2	17	5	23	7	11	5	23	11	39	4	21
40	23	2	22	5	23	7	16	5	23	11	43	4	20
41	23	2	27	5	23	7	21	4	23	11	47	4	19
42	23	2	32	6	23	7	25	5	23	11	51	4	18
43	23	2	38	5	23	7	30	4	23	11	55	5	17
44	23	2	43	5	23	7	34	5	23	12	0	4	16
45	23	2	48	5	23	7	39	5	23	12	4	4	15
46	23	2	53	5	23	7	44	4	23	12	8	4	14
47	23	2	58	5	23	7	48	5	23	12	12	4	13
48	23	3	3	5	23	7	53	5	23	12	16	4	12
49	23	3	8	5	23	7	58	4	23	12	20	5	11
50	23	3	13	5	23	8	2	5	23	12	25	4	10
51	23	3	18	5	23	8	7	4	23	12	29	4	9
52	23	3	23	5	23	8	11	5	23	12	33	4	8
53	23	3	28	5	23	8	16	4	23	12	37	4	7
54	23	3	33	5	23	8	20	5	23	12	41	4	6
55	23	3	38	5	23	8	25	5	23	12	45	4	5
56	23	3	43	5	23	8	30	4	23	12	49	5	4
57	23	3	48	5	23	8	34	5	23	12	54	4	3
58	23	3	53	5	23	8	39	4	23	12	58	4	2
59	23	3	58	5	23	8	43	5	23	13	2	4	1
60	23	4	3		23	8	48		23	13	6		0
		11				10				9			

Cancer. Capricorne.

	21			dif.	22			dif.	23			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se.	Se.	mi.
0	23	13	6	4	23	16	57	4	23	20	21	3	60
1	23	13	10	4	23	17	1	3	23	20	24	3	59
2	23	13	14	4	23	17	4	4	23	20	27	4	58
3	23	13	18	4	23	17	8	3	23	20	31	3	57
4	23	13	22	4	23	17	11	4	23	20	34	3	56
5	23	13	26	4	23	17	15	4	23	20	37	3	55
6	23	13	30	4	23	17	19	3	23	20	40	3	54
7	23	13	34	4	23	17	22	4	23	20	43	3	53
8	23	13	38	4	23	17	26	3	23	20	46	3	52
9	23	13	42	4	23	17	29	4	23	20	49	4	51
10	23	13	46	4	23	17	33	3	23	20	53	3	50
11	23	13	50	4	23	17	36	4	23	20	56	3	49
12	23	13	54	4	23	17	40	3	23	20	59	3	48
13	23	13	58	4	23	17	43	4	23	21	2	3	47
14	23	14	2	4	23	17	47	4	23	21	5	3	46
15	23	14	6	4	23	17	51	3	23	21	8	3	45
16	23	14	10	4	23	17	54	4	23	21	11	3	44
17	23	14	14	4	23	17	58	3	23	21	14	3	43
18	23	14	18	4	23	18	1	4	23	21	17	3	42
19	23	14	22	4	23	18	5	3	23	21	20	3	41
20	23	14	26	4	23	18	8	3	23	21	23	3	40
21	23	14	30	4	23	18	11	4	23	21	26	3	39
22	23	14	34	4	23	18	15	3	23	21	29	3	38
23	23	14	38	3	23	18	18	4	23	21	32	3	37
24	23	14	41	4	23	18	22	3	23	21	35	3	36
25	23	14	45	4	23	18	25	4	23	21	38	3	35
26	23	14	49	4	23	18	29	3	23	21	41	3	34
27	33	14	53	4	23	18	32	4	23	21	44	3	33
28	23	14	57	4	23	18	36	3	23	21	47	3	32
29	23	15	1	4	23	18	39	3	23	21	50	3	31
30	23	15	5	4	23	18	42	4	23	21	53	3	30
		8				7				6			

	21			dif.	22			dif.	23			dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	Mi.	Se	Se.	Deg.	Mi.	Se.	Se.	mi.
30	23	15	5	4	23	18	42	4	23	21	53	3	30
31	23	15	9	3	23	18	46	3	23	21	56	3	29
32	23	15	12	4	23	18	49	4	23	21	59	3	28
33	23	15	16	4	23	18	53	3	23	22	2	3	27
34	23	15	20	4	23	18	56	3	23	22	5	3	26
35	23	15	24	4	23	18	59	4	23	22	8	3	25
36	23	15	28	4	23	19	3	3	23	22	11	3	24
37	23	15	32	3	23	19	6	3	23	22	14	3	23
38	23	15	35	4	23	19	9	4	23	22	17	2	22
39	23	15	39	4	23	19	13	3	23	22	19	3	21
40	23	15	43	4	23	19	16	3	23	22	22	3	20
41	23	15	47	3	23	19	19	4	23	22	25	3	19
42	23	15	50	4	23	19	23	3	23	22	28	3	18
43	23	15	54	4	23	19	26	3	23	22	31	3	17
44	23	15	58	4	23	19	29	4	23	22	34	3	16
45	23	16	2	3	23	19	33	3	23	22	37	2	15
46	23	16	5	4	23	19	36	3	23	22	39	3	14
47	23	16	9	4	23	19	39	3	23	22	42	3	13
48	23	16	13	4	23	19	42	4	23	22	45	3	12
49	23	16	17	3	23	19	46	3	23	22	48	3	11
50	23	16	20	4	23	19	49	3	23	22	51	2	10
51	23	16	24	4	23	19	52	4	23	22	53	3	9
52	23	16	28	3	23	19	56	3	23	22	56	3	8
53	23	16	31	4	23	19	59	3	23	22	59	3	7
54	23	16	35	4	23	20	2	3	23	23	2	3	6
55	23	16	39	3	23	20	5	3	23	23	5	2	5
56	23	16	42	4	23	20	8	4	23	23	7	3	4
57	23	16	46	4	23	20	12	3	23	23	10	3	3
58	23	16	50	3	23	20	15	3	23	23	13	3	2
59	23	16	53	4	23	20	18	3	23	23	16	2	1
60	23	16	57	4	23	20	21	3	23	23	18	3	0
		8				7				6			

mi.	24 Deg. Mi. Se	dif. Se.	25 Deg. Mi. Se.	dif. Se.	26 Deg. Mi. Se.	dif Se	mi.
0	23 23 18	3	23 25 48	3	23 27 51	2	60
1	23 23 21	3	23 25 51	2	23 27 53	2	59
2	23 23 24	3	23 25 53	2	23 27 55	2	58
3	23 23 27	2	23 25 55	2	23 27 57	2	57
4	23 23 29	3	23 25 57	3	23 27 59	1	56
5	23 23 32	3	23 26 0	2	23 28 0	2	55
6	23 23 35	2	23 26 2	2	23 28 2	2	54
7	23 23 37	3	23 26 4	2	23 28 4	2	53
8	23 23 40	2	23 26 6	3	23 28 6	1	52
9	23 23 42	3	23 26 9	2	23 28 7	2	51
10	23 23 45	3	23 26 11	2	23 28 9	2	50
11	23 23 48	3	23 26 13	2	23 28 11	2	49
12	23 23 51	2	23 26 15	2	23 28 13	1	48
13	23 23 53	3	23 26 17	3	23 28 14	2	47
14	23 23 56	2	23 26 20	2	23 28 16	2	46
15	23 23 58	3	23 26 22	2	23 28 18	2	45
16	23 24 1	3	23 26 24	2	23 28 20	1	44
17	23 24 4	2	23 26 26	2	23 28 21	2	43
18	23 24 6	3	23 26 28	2	23 28 23	2	42
19	23 24 9	2	23 26 30	2	23 28 25	1	41
20	23 24 11	3	23 26 32	3	23 28 26	2	40
21	23 24 14	3	23 26 35	2	23 28 28	2	39
22	23 24 17	2	23 26 37	2	23 28 30	1	38
23	23 24 19	3	23 26 39	2	23 28 31	2	37
24	23 24 22	2	23 26 41	2	23 28 33	1	36
25	23 24 24	3	23 26 43	2	23 28 34	2	35
26	23 24 27	2	23 26 45	2	23 28 36	2	34
27	23 24 29	3	23 26 47	2	23 28 38	1	33
28	23 24 32	2	23 26 49	2	23 28 39	2	32
29	23 24 34	3	23 26 51	2	23 28 41	2	31
30	23 24 37	2	23 26 53	2	23 28 43	1	30
	5		4		3		

Cancer. Capricorne.

mi.	24 Deg. Mi. Se.	dif. Se.	25 Deg. Mi. Se.	dif. Se.	26 Deg. Mi. Se.	dif. Se.	mi.
30	23 24 37	2	23 26 53	2	23 28 43	1	30
31	23 24 39	3	23 26 55	2	23 28 44	2	29
32	23 24 42	2	23 26 57	2	23 28 46	1	28
33	23 24 44	3	23 26 59	2	23 28 47	2	27
34	23 24 47	2	23 27 1	2	23 28 49	1	26
35	23 24 49	3	23 27 3	2	23 28 50	2	25
36	23 24 52	2	23 27 5	2	23 28 52	1	24
37	23 24 54	3	23 27 7	2	23 28 53	2	23
38	23 24 57	2	23 27 9	2	23 28 55	2	22
39	23 24 59	2	23 27 11	2	23 28 57	1	21
40	23 25 1	3	23 27 13	2	23 28 58	2	20
41	23 25 4	2	23 27 15	2	23 29 0	1	19
42	23 25 6	3	23 27 17	2	23 29 1	2	18
43	23 25 9	2	23 27 19	2	23 29 3	1	17
44	23 25 11	2	23 27 21	2	23 29 4	2	16
45	23 25 13	3	23 27 23	2	23 29 6	1	15
46	23 25 16	2	23 27 25	2	23 29 7	2	14
47	23 25 18	3	23 27 27	2	23 29 9	1	13
48	23 25 21	2	23 27 29	2	23 29 10	1	12
49	23 25 23	2	23 27 31	2	23 29 11	2	11
50	23 25 25	3	23 27 33	2	23 29 13	1	10
51	23 25 28	2	23 27 35	1	23 29 14	2	9
52	23 25 30	2	23 27 36	2	23 29 16	1	8
53	23 25 32	3	23 27 38	2	23 29 17	2	7
54	23 25 35	2	23 27 40	2	23 29 19	1	6
55	23 25 37	2	23 27 42	2	23 29 20	1	5
56	23 25 39	3	23 27 44	2	23 29 21	2	4
57	23 25 42	2	23 27 46	2	23 29 23	1	3
58	23 25 44	2	23 27 48	1	23 29 24	2	2
59	23 25 46	2	23 27 49	2	23 29 26	1	1
60	23 25 48	3	23 27 51	2	23 29 27	1	0
	4		4		3		

	27			dif.	28				dif.	29				dif.	
mi.	Deg.	Mi.	Se	Se.	Deg.	Mi.	Se.	Th.	Th.	Deg.	Mi.	Se.	Th.	Th.	mi.
0	23	29	27	1	23	30	35	16	53	23	31	16	17	27	60
1	23	29	28	1	23	30	36	9	54	23	31	16	44	27	59
2	23	29	29	2	23	30	37	3	54	23	31	17	11	26	58
3	23	29	31	1	23	30	37	57	54	23	31	17	37	26	57
4	23	29	32	1	23	30	38	51	51	23	31	18	3	25	56
5	23	29	33	1	23	30	39	42	52	23	31	18	28	25	55
6	23	29	34	2	23	30	40	34	52	23	31	18	53	24	54
7	23	29	36	1	23	30	41	26	52	23	31	19	17	24	53
8	23	29	37	1	23	30	42	18	50	23	31	19	41	24	52
9	23	29	38	2	23	30	43	8	50	23	31	20	5	23	51
10	23	29	40	1	23	30	43	58	50	23	31	20	28	22	50
11	23	29	41	1	23	30	44	48	51	23	31	20	50	22	49
12	23	29	42	2	23	30	45	39	49	23	31	21	12	22	48
13	23	29	44	1	23	30	46	28	48	23	31	21	34	21	47
14	23	29	45	1	23	30	47	16	48	23	31	21	55	21	46
15	23	29	46	1	23	30	48	4	48	23	31	22	16	21	45
16	23	29	47	2	23	30	48	52	47	23	31	22	37	19	44
17	23	29	49	1	23	30	49	39	47	23	31	22	56	20	43
18	23	29	50	1	23	30	50	26	46	23	31	23	16	19	42
19	23	29	51	1	23	30	51	12	46	23	31	23	35	18	41
20	23	29	52	1	23	30	51	58	44	23	31	23	53	18	40
21	23	29	53	2	23	30	52	42	45	23	31	24	11	18	39
22	23	29	55	1	23	30	53	27	45	23	31	24	29	17	38
23	23	29	56	1	23	30	54	12	45	23	31	24	46	17	37
24	23	29	57	1	23	30	54	57	42	23	31	25	3	16	36
25	23	29	58	1	23	30	55	39	43	23	31	25	19	16	35
26	23	29	59	2	23	30	56	22	43	23	31	25	35	15	34
27	23	30	1	1	23	30	57	5	43	23	31	25	50	15	33
28	23	30	2	1	23	30	57	48	41	23	31	26	5	14	32
29	23	30	3	1	23	30	58	29	41	23	31	26	19	14	31
30	23	30	4	1	23	30	59	10	41	23	31	26	33	14	30
		2				1					0				

	27			dif.	28				dif.	29				dif.	
mi.	Deg.	Mi.	Se.	Se.	Deg.	M.	Se.	Th.	Th.	Deg.	Mi.	Se.	Th.	Th.	mi.
30	23	30	4	1	23	30	59	10	41	23	31	26	33	14	30
31	23	30	5	1	23	30	56	51	41	23	31	26	47	13	29
32	23	30	6	1	23	31	0	32	40	23	31	27	0	12	28
33	23	30	7	2	23	31	1	12	40	23	31	27	12	12	27
34	23	30	9	1	23	31	1	52	38	23	31	27	24	12	26
35	23	30	10	1	23	31	2	30	39	23	31	27	36	11	25
36	23	30	11	1	23	31	3	9	37	23	31	27	47	11	24
37	23	30	12	1	23	31	3	46	38	23	31	27	58	10	23
38	23	30	13	1	23	31	4	24	37	23	31	28	8	10	22
39	23	30	14	1	23	31	5	1	37	23	31	28	18	10	21
40	23	30	15	1	23	31	5	38	35	23	31	28	28	9	20
41	23	30	16	1	23	31	6	13	35	23	31	28	37	8	19
42	23	30	17	1	23	31	6	48	36	23	31	28	45	8	18
43	23	30	18	1	23	31	7	24	37	23	31	28	53	8	17
44	23	30	19	1	23	31	8	1	33	23	31	29	1	7	16
45	23	30	20	1	23	31	8	34	34	23	31	29	8	6	15
46	23	30	21	1	23	31	9	8	34	23	31	29	14	7	14
47	23	30	22	1	23	31	9	42	34	23	31	29	21	5	13
48	23	30	23	1	23	31	10	16	33	23	31	29	26	6	12
49	23	30	24	1	23	31	10	49	32	23	31	29	32	5	11
50	23	30	25	1	23	31	11	21	31	23	31	29	37	4	10
51	23	30	26	1	23	31	11	52	31	23	31	29	41	4	9
52	23	30	27	1	23	31	12	23	31	23	31	29	45	3	8
53	23	30	28	1	23	31	12	54	30	23	31	29	48	3	7
54	23	30	29	1	23	31	13	24	30	23	31	29	51	3	6
55	23	30	30	1	23	31	13	54	30	23	31	29	54	2	5
56	23	30	31	1	23	31	14	24	29	23	31	29	56	2	4
57	23	30	32	1	23	31	14	53	28	23	31	29	58	1	3
58	23	30	33	1	23	31	15	21	28	23	31	29	59	1	2
59	23	30	34	1	23	31	15	49	28	23	31	30	0	0	1
60	23	30	35	1	23	31	16	17	27	23	31	30	0	0	0
		2				1					0				

Chap. XVIII.

The vse of the Table of Declination.

THis Table of Declination is made so particularly to euery minute of the Ecliptick, to auoid tediousnes, in seeking the part proportional, when you would find out thereby either the declination of the Sunne, his place being first giuen in degrees and minutes: or else the place of the Sunne in the Zodiack his declination being first knowne by obseruation, for which cause especially this labour was vndertakē, that hereby it might presently appeare how wel the Ephemerides and Astronomicall Tables hitherto published agree with the truth of the heauens. Wherein many times no small difference is found, euen the Prutenick Tables themselues (which haue been hitherto accounted the most perfect in that kind) disagreeing halfe a degree and more from the truth, and that in the place of the Sunne, whose motion of all others is accounted most simple and regular and most easie to be found out.

To finde out the declination of the Sunne by his place first giuen, by helpe of this Table doe thus: If the Sunne be in *Aries, Taurus, Gemini, Libra, Scorpio,* or *Sagittarie,* seeke the signe and degree of the Sunne in the vpper margine or head of the Table, and the odde minutes (if there be any) in the first columne towards the left hand: Then looke where the line proceeding towards the right hand from the minute of the Sun, crosseth the columne comming downewards from the degree of the Sunne: for there you

haue

haue the declination of the Sunne. But if the Sun be in *Cancer*, *Leo*, *Virgo*, *Capricorne*, *Aquarie*, or *Piſces*, doe contrariwiſe, that is, ſeeke the ſigne and degrees of the Sunne in the nether margine or foote of the table, and the minutes (if there be any) in the laſt columne next the right hand: and following the line of the minute of the Sunne towards the left hand: and the columne of the degree of the Sunne vpwards, in the common meeting of that line and columne you ſhall finde the declination of the Sun.

Example of the firſt: The firſt of May 1609, the place of the Sunne is in 20 degrees, 45 minutes of *Taurus*, according to the Ephemerides of the Sun hereafter following, made agreeable to many exact obſeruations, taken by a quadrant of ſix foote and a quarter ſemidiameter in the yeares 1594, 1595, 1596, 1597: Finding therefore *Taurus* and the 20 degree in the vpper part of this table, and 45 minutes in the firſt columne, I haue in the common meeting (of the columne deſcending from 20, and of the line proceeding from 45 minutes towards the right hand) 18 degrees, 0 minutes 18 ſeconds, the declination of the Sunne the ſame day at noone here at London.

Example of the ſecond: The 15 of Auguſt the ſame yeere by the ſame Ephemerides, the Sunne is in 2 degr. 2 minutes of *Virgo*. Therefore I ſeeke *Virgo*, and 2 in the nether part of this table, and 50 minutes in the laſt columne towards the right hand aſcending vpwards. Then following the line of 2 minutes leftwards, and the columne of 2 degrees vpwards in the common meeting of the line and

columne, I finde ten degrees, 47 minutes, 19. ſec. the declination of the Sunne the ſame day at noone for the meridian of London.

But the declination of the Sun being firſt knowne (by obſeruation or otherwiſe) the place of the Sun ſhall moſt eaſily be found out by this table, after this manner: Seeke the Suns declination in the area of the table: then if the ſigne wherein the Sunne is (which you may for the moſt part eaſily know by eſtimation) be in the head of the table, aſcend vpwards to the top of the ſame columne in which you found the declination giuen, for there you ſhal haue the degree of the Sun: follow alſo the line wherein you finde the giuen declination towards the left hand, till you come to the firſt columne leftwards, and there you ſhall haue the minute alſo.

But if the name of the ſigne wherein the Sunne is, be in the nether part of the table, you muſt doe all things contrariwiſe, deſcending from the declination found in the area of this table in the ſame columne, till you come to the loweſt part thereof, where you ſhall finde the degree of the Sunne: and proceeding from the declination towards the right hand in the ſame line, till you come to the laſt columne, where you ſhall finde the minutes to be adioyned, that you may haue the true place of the Sunne.

This way of finding out the place of the Sunne by his declination, firſt knowne by obſeruation, is then of eſpeciall vſe and truth, when the Sunne is neere the æquinoctiall points; for there, his declination altereth quickeſt, increaſing or decreaſing about

about 24 min. in 24 houres. But when the Sunne is neere either of the Tropicks, the missing of one minute, yea or halfe a minute in obseruing the declination, may cause you erre an whole degree and more in the place of the Sunne. Hee therefore that listeth trie how well the Ephemerides and Astronomicall tables hitherto published agree with the truth of the heauens, had best make obseruation when the Sunne is in *Pisces*, *Aries*, *Virgo*, and *Libra*, where missing one whole minute in obseruing the declination, will cause you misse not past two minutes and an halfe in the true place of the Sun.

When the Sunne is neere either of the æquinoctiall points, there may sometimes bee some small difficultie in finding out what signe the Sunne is in, which may easily be auoided thus: The meridian altitude of the Sunne increasing (as in winter and spring time) if the heigth of the Sunne be lesse then the complement of the poles eleuation, the Sunne is in *Pisces*: otherwise in *Aries*. But if the meridian altitudes of the Sun be euery day lesse then other, (as in summer and Autumne) and the heigth of the Sunne at noone greater then the heigth of the æquinoctiall, the Sunne is in *Virgo*, otherwise in *Libra*.

There may likewise be some doubt in what signe the Sunne is, being neere either of the Tropicks, which may bee resolued thus: the Sunne hauing South declination increasing, is in *Sagittarie*: but if the declination of the Sunne be Southerly and decreasing, hee is in *Capricorne*. Contrariwise the declination of the Sun being Northerly and increasing,

sing, he is in *Gemini*, if decreasing, he is in *Cancer*.

Now whether the declination of the Sunne increase or decrease, you may know by comparing the declinations of two daies together. For if the declination answerable to the second day be greater, the declination increaseth: otherwise it decreaseth. If both daies haue equall declination, the first day the Sunne is in *Gemini*, the second in *Cancer*, if his declination be Northerly; if Southerly, the first day he is in *Sagittarie*, the second in *Capricorne*.

An example or two will make all plaine: The eighth day of April 1597, the declination of the Sunne was found by obseruation to be ten degrees, 55 minutes, 27 seconds, which I seeke out in the area of this table: and in the head of the same columne, in which I finde the declination that commeth neerest vnto this, that is 10 degr. 55 min. 33 sec. I see 28 degrees of *Aries* (for in Aprill the Sunne cannot be in *Libra*) and in the same line wherein I found this declination, in the furthest columne towards the left hand I finde 21 minutes, out of which abate 17 seconds, that is, the part proportionall answerable to 6 sec. which is the excesse of 10 degr. 55 minutes, 33 sec. (the declination found in the table) aboue 10 degr. 55 min. 27 sec. (the declination found by obseruation) and there shall remaine the true place of the Sun the same yeere and day 28 degr. 20 min. 43 sec. of *Aries*. Which *Maginus* following *Copernicus* and the Prutenicall tables (as he professeth) maketh to be the 27 degr. 57 minutes of *Aries* almost: that is, 24 minutes lesse then truth, that æquation also being abated, which is answerable to the difference of longitude

longitude betwixt London and Venice.

The 11 of March the ſame yeere at London (where by many and diligent obſeruations by large and ſeuerall inſtruments, the heigth of the pole is found to be 51 degrees, 32 minutes) the apparent meridian altitude of the Sun was exactly obſerued to be 38 degrees, 49 minutes: but being corrected by the parallax and refraction of the Sunne, anſwerable to that height, his true height ſhall be 38 degr. 51 min. 4 ſec. Whereby it appeareth that his true declination the ſame day at noone was 0 degr. 23 min. 4 ſec. and that Northerly, becauſe the heigth of the Sun was greater then the heigth of the æquinoctial. It is plaine therefore that at that time the Sunne was entred into *Aries*. But now to know how farre he was entred; ſeeke out 0 degr. 23 min. 4 ſec. or the number next to it, which is 0 degr. 23. min. 9. ſec. in the area of this table: wherwith you ſhall alſo finde in the ſame line in the columne next the left hand 58 minutes, and in the top of the columne right ouer this declination you ſhall haue 0 degree. Therefore it is manifeſt that at that time the Sun was in 0 degr. 58 min. of *Aries* almoſt, for there wanteth onely 12 ſeconds hereof, that is, the part proportionall anſwerable to the exceſſe of 9. ſec. aboue 4 ſec. Where *Maginus*, after the Prutenick account, maketh it to be in 0 degr. 25 min. of *Aries*; that is, 33 minutes wanting of the truth found by obſeruation.

The like difference I haue often found by many and diligent obſeruations, eſpecially for the ſpace of the foure yeeres before mentioned: the whole catalogue of which obſeruations I thought good (for

thy

thy further ſatisfaction herein) to ſet downe in a table, (after I haue firſt ſhewed with what inſtrument and after what manner I obſerued the ſame) that if any error herein hath been committed, it may the more eaſily appeare, and be amended.

Chap. XIX.

The deſcription and vſe of a great Quadrant, for obſeruation of the Sunne on land.

THe inſtrument therfore wherewith I tooke thoſe obſeruations was a quadrant of more then ſix foote and a quarter ſemidiameter, (for the roome wherein I was to vſe it, could not well admit a greater quantitie) which by reaſon of his largenes was ſo exactly made and diuided, that both minutes and halfe minutes mought therein be eaſily diſcerned. The limb and ſides of the quadrant were about two inches and a quarter in thickneſſe: the breadth of the limbe about foure inches: the breadth of the ſides about two inches and an half.

In the midſt of the ends of one ſide of this quadrant were two round holes made, in either end one: whereby the quadrant was hanged (like a gate on his hinges, vpon two round pins, fitted to thoſe holes, and fixed in the ends of a couple of ſockets, put cloſe vpon a ſtrong ſquare poſt, perpendicularly erected, and the vpper end thereof faſtned to the ſide of a principal ratter in an vpper chamber, where a window (according to the reclination of the roof of the houſe) was made betweene it and the next rafter, in ſuch ſort, that carrying your eye along by the

the circumference of the quadrant, you might by the center therof placed at the window, ſee any part of the heauens neere the meridian, from the zenith to the horizon. The nether end of this poſt reſting on the floore was put into the midſt of a ſocket nailed to the floore, which was ſo wide, that on euerie ſide the poſt, wedges might be put in to coyne it at pleaſure this way or that way, till the ſide of the quadrant were found to ſtand exactly perpendicular, by the hanging of the plumbe line all alongſt moſt preciſely vpon a line parallel to the zenith line of the quadrant. To the center of the quadrant was faſtned a ſtrong ruler of one inch in thicknes, two inches in breadth, and almoſt ſix foote and an halfe in length, carrying two ſights vpon it (viz. at either end one) of equall breadth and length, the end of the middle line of each ſight falling perpendicularly vpon the middle or fiduciall line and plaine ſuperficies of the ruler. Through the vpper ſight placed at the center was made a ſquare hole as great as it could well be. Through the midſt of this ſight and hole was put a ſtraight wire, erected perpendicularly from the fiduciall line and plaine of the ruler, and ſo much of it made flat and thin, as was betweene the top and baſe of that ſquare hole. This wire ſerued for obſeruing the ſtarres, the flat ſide whereof was to be turned towards the eye in obſeruing of great ſtarres, and the narrow ſide or edge of it was turned to the eyeward when ſmall ſtars were to bee obſerued. Through the midſt of the nether ſight (from the toppe of it to the baſe thereof) was made a narrow ſlit perpendicularly erected likewiſe

from

from the fiduciall line and plaine of the ruler and quadrant. When I obſerued the ſtarres, I looked through this ſlit, eleuating and depreſſing the ruler, till the wire (being firſt fitted to the bigneſſe of the ſtarre) did euen couer the ſtarre from my ſight: in ſuch ſort, that I might ſee both edges of the ſtarre alike on either ſide aboue and beneath the wire. The ſquare hole in the ſight had a couer fitted to it like the couer of a box wherewith it was wholly couered when the Sun was to be obſerued. The nether end of the ruler carrying the ſights, was to be faſtned with a ſcrue pin, at any part of the circumference of the quadrant as need required.

With this quadrant (alwaies rectified by the plumbe-line in time of obſeruation, as before is ſhewed) the height of the Sun was moſt eaſily and exactly obſerued, by turning the quadrant this way or that way, and eleuating or depreſſing the ruler carrying the ſights, till the top and ſides of the ſhadow of the vpper ſight placed at the center, fell vpon the nether ſight placed at the circumference, equidiſtantly from the top and ſides thereof: For then the vpper edge of the ruler ſhewed preciſely the height of the Sunne deſired in degrees and minutes vpon the limbe of the quadrant: ſauing that one whole degree was alwaies to be added thereto, becauſe the breadth of that part of the ruler that lay vpon the limb of the quadrant was made to be iuſt equall to two degrees: that is, on either ſide one degree from the fiduciall line.

Now for finding out the meridian altitudes of the Sunne and ſtarres, I firſt found the meridian line thus:

thus: With the quadrant rectified and vſed, as before is ſhewed, I obſerued the height of the Sun in the forenoone; and ſo warily letting the quadrant ſtand immoueable, and laying the ſide of a ſtreight ruler (that was about ſeuen foote in length) cloſe along to the perpendicular ſide of the quadrant: cloſe by the end of that ſide of the ruler (touching the floore of the chamber) I made a pricke vpon the floore: Alſo laying the ſide of the ruler to the perpendicular ſide, and limb of the quadrant, I made in like manner another pricke (ſo farre as conuenientlyI could from the former) vpon the floore, cloſe by the corner of that ſide of the ruler.

By theſe two pricks, I drew a right line which repreſented the interſection of the Sunnes azimuth, or of the continued plaine of the quadrant, and of the plaine of the floore, in the time of obſeruation. Likewiſe in the afternoone (the ruler of the quadrant carrying the ſights, being fixed in the ſame place where it was in time of obſeruation, in the forenoone) I obſerued diligently till the Sun came to the ſame height that hee had when I obſerued in the forenoone, which I did by following the motion of the Sunnes ſhadow with the quadrant, till the edges of the top and ſides of the ſhadow of the vpper ſight fell vpon the nether ſight equidiſtantly from the top and ſides thereof.

Then carefully letting the quadrant ſtand immoueable, and drawing the line of interſection of the floore, and Sunnes azimuth, in time of the afternoone obſeruation, in like manner as I did in the forenoone, ſetting one foote of the compaſſes in the interſection

interſection of thoſe two lines, with the other, drawing an arch, ſo great as I could betweene the ſame lines, and finding out the midſt of this arch, a line from the center drawne, by this midſt was the meridian line: ouer which, with helpe of a long ruler laid to the vpright ſide, & limbe of the quadrant, and extended to the floore (as before) I alwaies placed and faſtned the plaine of the quadrant (vnderſtood to be continued to the floore) ſo oft as I obſerued the meridian altitudes of the Sunne or Starres.

Notwithſtanding there is ſome little error in finding the meridian after this manner, except it bee when the Sunne is in, or ſo neere one of the tropicall points, that there can be no ſenſible alteration of his declination between the times of the forenoone and afternoone obſeruations. But the conſequents of this error, in obſeruing meridian altitudes, may for their ſmalneſſe iuſtly bee neglected, and eaſilie auoided, if you attend your obſeruation, but a little before and after the Sunne or Starres to be obſerued, come vpon the meridian thus found. And for the more certaintie, I tooke three obſeruations in the forenoone, and as many in the afternoone, and ſo found out three meridian lines, all parallels each to other without notable difference, which if it ſhould haue chanced to be any, the middlemoſt meridian ſhould be like to be the trueſt.

A TABLE OF OBSERVATIONS OF THE Meridian altitudes of the Sunne, taken *by a large Quadrant of more then six* foote Semidiameter in the yeeres 1594, 1595, 1596, 1597, at *London*, where the eleuation of the Pole was by the same Quadrant and otherwise also, exactly obserued and found to be one and fiftie degrees, and two and thirtie minutes.

1594 May.	The Sunnes Apparent height.			The Sunnes True height.			The Sunnes apparent declination.		
Day.	Deg.	Min.	Sec.	Deg.	Min.	Sec.	Degr.	Min.	Sec.
9 Thurſd.	58	14		58	15	36	19	46	0
11 Satur.	58	41		58	42	33	20	13	0
13 Mund.	59	4		59	5	33	20	36	0
14 Tueſd.	59	15		59	16	33	20	47	0
17 Frid.	59	45		59	46	30	21	17	0
26 Sund.	61	1	30	61	2	58	22	33	30
27 Mund.	61	8		61	9	28	22	40	0
28 Tueſd.	61	14		61	15	28	22	46	0
29 Wedneſ.	61	20	30	61	21	58	22	52	30
31 Frid.	61	31		61	32	25	23	3	0
Iune.									
1 Saturd.	61	35		61	36	25	23	7	0
2 Sund.	61	40		61	41	25	23	12	0
4 Tueſd.	61	46	30	61	47	55	23	18	30
6 Thurſ.	61	52	30	61	53	55	23	24	30
7 Frid.	61	54		61	55	25	23	26	0
8 Saturd.	61	55	30	61	56	55	23	27	30
9 Sund.	61	56	30	61	57	55	23	28	30
10 Mond.	61	57		61	58	25	23	29	0
11 Tueſd.	61	58		61	59	25	23	30	0
12 Wedneſ.	61	58		61	59	25	23	30	0
13 Thurſd.	61	57	30	61	58	55	23	29	30
14 Frid.	61	57		61	58	25	23	29	0
15 Saturd.	61	56		61	57	25	23	28	0
22 Saturd.	61	35		61	36	25	23	7	0
23 Sund.	61	32		61	33	25	23	4	0
24 Mund.	61	26	30	61	27	58	22	58	30
Iuly.									
6 Saturd.	59	56	00	59	57	30	21	28	0
8 Mond.	59	36	30	59	38	00	21	8	30

The Sunnes true declination.			*The Suns place by obſervation.*			*The Suns place by Prutenick Tables.*			*The difference.*	
Deg.	*Min.*	*Sec.*	*Deg.*	*Min.*	*Sec.*	*Deg.*	*Min.*	*Sec.*	*Min*	*Sec.*
19	47	36	28	2	0	27 ♉	43	0	19	0
20	14	33	♊	5	30	29	39	0	26	30
20	37	33	I	57	0	I ♊	34	0	23	0
20	48	33	2	52	40	2	32	0	20	40
21	18	30	5	33	40	5	25	0	8	40
22	34	58	14	10	30	14	2	0	8	30
22	41	28	15	7	0	15	0	0	7	0
22	47	28	16	3	0	15	57	0	6	0
22	53	58	17	7	30	16	55	0	12	30
23	4	25	19	4	30	18	50	0	14	30
23	8	25	19	55	0	19	47	0	8	0
23	13	25	21	5	0	20	44	0	21	0
23	49	55	22	52	0	22	39	0	13	0
23	25	55	25	3	0	24	34	0	29	0
23	27	25	25	46	0	25	31	0	15	0
23	28	25	26	19	0	26	29	0	10	0
23	29	55	27	22	0	27	26	0	4	0
23	30	25	27	50	0	28	23	0	33	0
23	31	25	29	24	0	29	21	0	3	0
23	31	25	0 ♋	35	0	0 ♋	18	0	17	0
23	30	55	I	36	0	I	15	0	21	0
23	30	25	2	10	0	2	12	0	2	0
23	29	25	3	1	30	3	10	0	8	30
23	8	25	10	5	0	9	51	0	46	0
23	5	25	10	43	0	10	48	0	5	0
22	59	58	11	47	30	11	45	0	2	0
21	29	30	23	23	0	23	13	0	10	0
21	10	0	25	13	40	25	8	0	5	40

1594 Iuly.	The Sunnes Apparent height.			The Sunnes True height.			The Sunnes apparent declination.		
Day.	Deg.	Min.	Sec.	Deg.	Min.	Sec.	Degr.	Min.	Sec.
9 Tueſd.	59	26	0	59	27	33	20	58	0
15 Mond.	58	14	0	58	15	34	19	46	0
16 Tueſd.	58	1	0	58	2	36	19	33	0
19 Frid.	57	20	0	57	21	39	18	52	0
25 Thurſd.	55	50	0	55	51	41	17	22	0
31 Wedneſ.	54	9	30	54	11	11	15	41	30
Auguſt.									
3 Saturd.	53	15	30	53	17	18	14	47	30
6 Tueſd.	52	19	30	52	21	21	13	51	30
7 Wedneſ.	52	0	0	52	1	51	13	32	0
8 Thurſ.	51	40	30	51	42	21	13	12	30
9 Frid.	51	21	30	51	23	24	12	53	30
12 Mond.	50	23	0	50	24	54	11	55	0
15 Thurſd.	49	21	0	49	22	58	10	53	0
19 Mond.	47	57	0	47	47	59	9	29	0
23 Frid.	46	30	0	46	32	2	8	2	0
24 Satur.	46	7	30	46	9	35	7	39	30
26 Mond.	45	23	30	45	25	32	6	55	30
29 Thurſd.	44	16	0	44	18	4	5	48	0
September.									
16 Mond.	37	18	0	37	19	58	1	10	0
17 Tueſd.	36	54	0	36	55	58	1	34	0
19 Thurſd.	36	7	0	36	8	55	2	21	0
20 Frid.	35	44	0	35	45	55	2	44	0
October.									
1 Tueſday.	31	28	0	31	29	19	7	0	0
3 Thurſd.	30	43	30	30	44	49	7	44	30
4 Friday.	30	21	0	30	22	11	8	7	0
5 Saturd.	29	58	30	29	59	41	8	29	30
16 Wedneſ.	26	0	30	26	0	58	12	27	30

The Sunnes true declination.			The Suns place by obseruation.			The Suns place by Prutenick Tables.			The difference.	
Deg.	Min.	Sec.	Deg.	Min.	Sec.	Deg.	Min.	Sec.	Min	Sec.
20	59	33	26	10	0	26	5	0	5	0
19	47	34	1 ♌	58	0	1 ♌	50	0	8	0
19	34	36	2	55	0	2	47	0	11	0
18	53	39	5	47	45	5	39	0	8	45
17	23	41	11	29	52	11	25	0	4	52
15	43	11	17	15	6	17	10	0	5	6
14	49	18	20	8	30	20	3	0	5	30
13	53	21	23	2	0	22	57	0	5	0
13	33	51	24	1	0	23	54	0	7	0
13	14	21	24	59	0	24	52	0	7	0
12	55	24	25	55	20	25	50	0	5	20
11	56	54	28	45	24	28	44	0	1	24
10	54	58	1 ♍	40	36	1 ♍	38	0	2	36
9	19	59	6	1	40	5	30	0	31	40
8	4	2	9	25	0	9	22	0	3	0
7	41	35	10	24	15	10	21	0	3	15
6	57	32	12	19	45	12	17	0	2	45
5	50	4	15	14	45	15	12	0	2	45
1	8	2	2 ♎	50	30	2 ♎	48	0	2	0
1	32	2	3	50	42	3	47	0	2	42
2	19	5	5	49	0	5	45	0	2	0
2	42	5	6	46	52	6	44	0	2	52
6	58	41	17	43	13	17	35	0	6	13
7	43	11	19	40	0	19	34	0	6	0
8	5	49	20	39	48	20	33	0	6	48
8	28	19	21	39	36	21	33	0	6	36
12	27	2	2 ♏	40	36	2 ♏	30	0	10	0

1594 October.	The Sunnes.						The Sunnes apparent declination.		
	Apparent height.			True height.					
Day.	Degr.	Min.	Sec.	Degr.	Min.	Sec.	Degr.	Min.	Sec.
18 Friday.	25	20	30	25	20	44	13	7	30
19 Saturd.	25	0	0	25	0	14	13	28	0
21 Mond.	24	20	0	24	19	45	14	8	0
25 Friday.	23	5	0	23	4	16	15	23	0
29 Tuesd.	21	52	0	21	50	48	16	36	0
Nouember.									
1 Friday.	21	0	0	20	58	19	17	28	0
3 Sund.	20	27	0	20	24	50	18	1	0
4 Mond.	20	12	0	20	9	50	18	16	0
7 Thursd.	19	27	0	19	24	20	19	1	0
10 Sund.	18	43	0	18	40	20	19	45	0
19 Tuesd.	16	55	0	16	51	22	21	33	0
20 Wednes	16	45	0	16	41	22	21	43	0
22 Friday.	16	27	0	16	22	53	22	1	0
23 Saturd.	16	18	0	16	13	53	22	10	0
27 Wednes.	15	48	0	15	43	53	22	40	0
28 Thursd.	15	41	0	15	36	53	22	47	0
29 Friday.	15	35	0	15	30	53	22	53	0
December.									
17 Tuesd.	15	6	0	15	1	24	23	22	0
18 Wednes.	15	9	0	15	4	24	23	19	0
20 Friday.	15	16	0	15	11	24	23	12	0
22 Sunday.	15	25	0	15	20	24	23	3	0
29 Sunday.	16	10	30	16	6	23	22	17	30
Ianuary.									
9 Thursd.	18	4	30	18	1	21	20	23	30
18 Saturd.	30	13	0	20	10	50	18	15	0
23 Thursd.	21	35	0	21	33	48	16	53	0
26 Sunday.	22	28	30	22	27	18	15	59	30
31 Friday.	24	3	0	24	2	45	14	25	0

The Sunnes true declination.			The Suns place by obseruation.			The Suns place by Prutenick Tables.			The difference.	
Degr.	Mi.	Sec.	Degr.	Min.	Sec.	Degr.	Min.	Sec.	Min.	Sec.
13	7	16	4	42	42	4	30	0	12	42
13	27	46	5	40	51	5	30	0	10	51
14	8	15	7	43	45	7	30	0	13	45
15	23	44	11	41	30	11	30	0	11	30
16	37	12	15	46	20	15	31	0	14	20
17	29	41	18	51	48	18	32	0	19	48
18	3	10	20	55	48	20	33	0	22	48
18	18	10	21	53	4	21	33	0	20	4
19	3	40	24	54	12	24	35	0	19	12
19	47	40	28	2	25	27	36	0	26	25
21	36	38	7 ♓	19	30	6 ♓	43	0	36	30
21	46	38	8	21	12	7	43	0	38	12
22	5	7	10	23	6	9	45	0	38	6
22	14	7	11	27	0	10	46	0	41	0
22	44	7	15	31	20	14	49	0	42	20
22	51	7	16	38	30	15	50	0	48	30
22	57	7	17	40	50	16	48	0	52	50
23	26	36	4 ♑	38	30	5 ♑	10	0	31	30
23	23	36	5	53	30	6	11	0	18	30
23	16	36	8	5	45	8	13	0	7	15
23	7	36	10	15	36	10	16	0	0	24
22	21	37	17	37	0	17	23	0	14	0
20	26	39	28	56	40	28	35	0	21	4
18	17	10	8 ♒	10	45	7 ♒	43	0	27	45
16	54	12	13	14	38	12	47	0	27	38
16	0	42	16	17	10	15	50	0	27	10
14	25	15	21	23	48	20	53	0	30	48

1595 February.	The Sunnes Apparent height.			The Sunnes True height.			The Sunnes apparent declination.		
Day.	Deg.	Min.	Sec.	Deg.	Min.	Sec.	Degr.	Min.	Sec.
1 Saturd.	24	22	0	24	21	45	14	6	0
5 Wedneſ.	25	43	0	25	43	28	12	45	0
8 Satur.	26	46	0	26	46	41	11	42	0
13 Thurſd.	28	33	0	28	34	2	9	55	0
15 Saturd.	29	19	0	29	20	2	9	9	0
16 Sund.	29	40	30	29	41	41	8	47	30
17 Mond.	30	3	0	30	4	11	8	25	0
20 Thurſd.	31	11	30	31	12	49	7	16	30
21 Frid.	31	34	0	31	35	27	6	54	0
27 Thurſd.	33	54	0	33	55	44	4	34	0
March.									
1 Saturd.	34	40	0	34	41	52	3	48	0
3 Mond.	35	27	0	35	28	52	3	1	0
12 Wedneſ.	39	0	0	39	2	4	0	32	0
15 Saturd.	40	10	0	40	12	8	1	42	0
17 Mond.	40	58	0	41	0	7	2	30	0
18 Tueſd.	41	22	0	41	24	7	2	54	0
19 Wedneſ.	41	45	0	41	47	6	3	17	0
20 Thurſ.	42	9	0	42	11	6	3	41	0
21 Frid.	42	31	0	42	33	5	4	3	0
25 Tueſd.	44	4	0	44	6	4	5	36	0
26 Wedneſ.	44	26	30	44	28	34	5	58	30
27 Thurſd.	44	49	0	44	51	2	6	21	0
31 Mond.	46	19	0	46	21	5	7	51	0
Aprill.									
3 Thurſd.	47	25	0	47	27	3	8	57	0
7 Mond.	48	51	0	48	52	58	10	23	0
8 Tueſday.	49	12	0	49	13	58	10	44	0
14 Mond.	51	14	0	51	15	54	12	46	0

The Sunnes true declination.			*The Suns place by obſervation.*			*The Suns place by Prutenick Tables.*			*The difference.*	
Degr.	*Min.*	*Sec.*	*Degr.*	*Min.*	*Sec.*	*Degr.*	*Min.*	*Sec.*	*Min.*	*Sec.*
14	6	15	22	22	24	21	53	0	29	24
12	44	32	26	27	18	25	56	0	31	18
11	41	19	29	29	54	28	57	0	32	54
9	53	58	4 ♓	29	14	3 ♓	59	0	30	14
9	7	58	6	34	6	5	59	0	35	6
8	46	19	7	32	18	6	59	0	33	18
8	23	49	8	32	23	7	59	0	33	23
7	15	11	11	33	36	11	0	0	33	36
6	52	33	12	32	45	12	0	0	32	45
4	32	16	18	34	3	17	59	0	35	3
3	46	8	20	31	17	19	59	0	32	17
2	59	8	22	30	8	21	58	0	32	8
0	34	4	1 ♈	25	22	0 ♈	55	0	30	22
1	44	8	4	21	5	3	53	0	28	5
2	32	7	6	21	45	5	51	0	30	45
2	56	7	7	22	15	6	50	0	32	15
3	19	6	8	20	18	7	50	0	30	18
3	43	6	9	21	3	8	49	0	32	3
4	5	5	10	16	48	9	48	0	28	48
5	38	4	14	14	23	13	44	0	30	23
6	0	34	15	12	20	14	43	0	29	20
6	23	2	16	10	30	15	42	0	28	30
7	53	5	20	6	5	19	38	0	28	5
8	59	3	23	1	52	22	34	0	27	52
10	24	58	26	56	0	26	28	0	28	0
10	45	58	27	54	16	27	27	0	27	16
12	47	54	3 ♉	42	33	3 ♉	18	0	24	33

1595 May.	The Sunnes Apparent height.			The Sunnes True height.			The Sunnes apparent declination.		
Day.	Deg.	Min.	Sec.	Deg.	Min.	Sec.	Degr.	Min.	Sec.
3 Saturd.	56	47	0	56	48	39	18	19	0
6 Tueſd.	57	29	30	57	31	9	19	1	30
14 Wedneſ.	59	10	0	59	11	33	20	42	0
17 Saturd.	59	43	30	59	45	0	21	25	30
21 Wedneſ.	60	21	30	60	23	0	21	53	30
23 Friday.	60	38	0	60	39	28	22	10	0
24 Saturd.	60	46	0	60	47	28	22	18	0
29 Thurſd.	61	19	0	61	20	28	22	51	0
Iune.									
7 Saturd.	61	54	0	61	55	25	23	26	0
9 Mond.	61	56	30	61	57	55	23	28	30
21 Saturd.	61	40	30	61	41	55	23	12	30
23 Mond.	61	32	0	61	33	25	23	4	0
26 Thurſd.	61	16	0	61	17	28	22	48	0
Iuly.									
30 Wedneſ.	54	30	0	54	31	45	16	2	0
31 Thurſ.	54	14	0	54	15	46	15	46	0
Auguſt.									
1 Frid.	53	56	0	53	57	46	15	28	0
2 Saturd.	53	37	0	53	38	46	15	9	0
8 Frid.	51	45	0	51	46	51	13	17	0
9 Satur.	51	26	0	51	27	54	12	58	0
10 Sund.	51	6	0	51	7	54	12	38	0
19 Tueſd.	48	2	0	48	4	0	9	34	0
21 Thurſd.	47	20	0	47	22	3	8	52	0
23 Friday.	46	57	30	46	59	33	8	29	30
26 Tueſd.	45	30	0	45	32	4	7	2	0
29 Friday.	44	22	0	44	24	4	5	54	0

The Sunnes true declination.			The Suns place by obseruation.			The Suns place by Prutenick Tables.			The difference.	
Degr.	Min.	Sec.	Degr.	Min.	Sec.	Degr.	Min.	Sec.	Min.	Sec.
18	20	39	22	2	40	21	42	0	20	40
19	3	9	24	52	4	24	36	0	16	4
20	43	33	2 ♊	27	10	2 ♊	17	0	10	10
21	17	0	5	25	12	5	10	0	15	12
21	55	0	9	15	0	9	1	0	14	0
22	11	28	11	7	45	10	56	0	11	45
22	19	28	12	6	38	11	53	0	13	38
22	52	28	16	52	10	16	40	0	12	10
23	27	25	25	46	0	25	17	0	29	0
23	29	55	27	22	0	27	12	0	10	0
23	13	55	8 ♋	47	45	8 ♋	39	0	8	45
23	5	25	10	43	15	10	34	0	9	15
22	49	28	13	37	50	13	26	0	11	50
16	3	45	16 ♌	7	0	15 ♌	58	0	9	0
15	47	46	17	0	3	16	56	0	4	3
15	29	46	17	58	57	17	54	0	4	57
15	10	46	19	0	16	18	51	0	9	16
13	18	51	24	45	48	24	38	0	7	48
12	59	54	25	42	6	25	36	0	6	6
12	39	54	26	40	54	26	34	0	6	54
9	36	0	5 ♍	18	14	5 ♍	15	0	3	14
8	54	3	7	11	32	7	12	0	0	28
8	31	33	8	11	46	8	10	0	1	46
7	4	4	12	2	44	12	3	0	0	16
5	56	4	14	59	16	14	58	0	1	16

1595 September.	The Sunnes Apparent height.			The Sunnes True height.			The Sunnes apparent declination.		
Day.	Degr.	Min.	Sec.	Degr.	Min.	Sec.	Degr.	Min.	Sec.
7 Sund.	40	54	0	40	56	7	2	26	0
8 Mond.	40	30	0	40	32	7	2	2	0
9 Tuesd.	40	7	0	40	9	8	1	39	0
10 Wed.	39	44	0	39	46	8	1	16	0
11 Thursd.	39	20	0	39	22	5	0	52	0
16 Tuesd.	37	23	30	37	25	29	1	4	30
17 Wed.	37	0	0	37	1	58	1	28	0
18 Thursd.	36	36	0	36	37	58	1	52	0
19 Friday.	36	12	0	36	13	55	2	16	0
20 Saturd.	35	48	30	35	50	25	2	39	30
23 Tuesd.	34	38	0	34	39	52	3	50	0
26 Friday.	33	29	0	33	30	39	4	59	0
October.									
2 Thursd.	31	11	30	31	12	49	7	16	30
3 Friday.	30	48	0	30	49	19	7	40	0
9 Thursd.	28	35	0	28	35	59	9	53	0
11 Saturd.	27	52	0	27	52	54	10	36	0
12 Sund.	27	30	0	27	30	47	10	58	0
15 Wednes	26	26	30	26	27	3	12	1	30
17 Friday.	25	45	0	25	45	25	12	43	0
30 Thursd.	21	37	30	21	36	8	16	50	30
Nouemb.									
18 Tuesd.	17	8	0	17	4	26	21	20	0
19 Wed.	16	58	0	16	54	21	21	30	0
20 Thursd.	16	48	0	16	44	16	21	40	0
24 Mond.	16	13	30	16	9	30	22	14	30

The Sunnes true declination.			*The Suns place by obseruation.*			*The Suns place by Prutenick Tables.*			*The difference.*	
Degr.	*Min.*	*Sec.*	*Degr.*	*Min.*	*Sec.*	*Degr.*	*Min.*	*Sec.*	*Min.*	*Sec.*
2	28	7	23	48	18	23	44	0	4	18
2	4	7	24	48	42	24	43	0	5	42
1	41	8	25	46	25	25	41	0	5	25
1	18	8	26	44	10	26	40	0	4	10
0	54	5	27	44	27	27	39	0	5	27
1	2	31	2 ♒	36	40	2 ♒	33	0	3	40
1	26	2	3	35	40	3	32	0	3	40
1	50	2	4	35	55	4	31	0	4	55
2	14	5	5	36	22	5	30	0	6	22
2	37	35	6	35	32	6	29	0	6	32
3	48	8	9	33	52	9	26	0	7	52
4	57	21	12	29	57	12	24	0	5	57
7	15	11	18	26	22	18	20	0	6	22
7	38	41	19	28	5	19	19	0	9	5
9	52	1	25	25	27	25	17	0	8	27
10	35	6	27	24	3	27	16	0	8	3
10	57	13	28	25	40	28	16	0	9	40
12	0	57	1 ♍	26	14	1 ♍	15	0	11	14
12	42	35	3	26	57	3	15	0	11	57
16	51	52	16	37	14	16	16	0	21	14
21	23	34	6 ♓	2	30	5 ♓	27	0	35	30
21	33	39	7	1	33	6	28	0	33	33
21	43	44	8	3	0	7	28	0	35	0
22	18	30	11	59	22	11	32	0	27	22

1595 December.	The Sunnes Apparent height.			The Sunnes True height.			The Sunnes apparent declination.		
Day.	Degr.	Min.	Sec.	Degr.	Min.	Sec.	Degr.	Min.	Sec.
2 Tueſd.	15	20	30	15	15	34	23	7	30
10 Wedneſ.	15	0	0	14	55	30	23	28	0
12 Friday.	14	58	0	14	53	23	23	30	0
18 Thurſd.	15	8	0	15	3	28	23	20	0
20 Saturd.	15	14	0	15	9	31	23	14	0
21 Sund.	15	18	0	15	13	33	23	10	0
24 Wed.	1	34	0	15	29	40	22	54	0
30 Tueſd.	16	16	0	16	12	0	22	12	0
1596. *Ianuary.*									
1 Thurſd.	16	34	0	16	30	7	21	54	0
3 Saturd.	16	53	0	16	44	18	21	35	0
10 Saturd.	18	14	0	28	18	58	20	14	0
12 Mond.	18	39	30	18	36	40	19	48	30
14 Wedneſ.	19	8	0	19	5	24	19	20	0
22 Thurſd.	21	14	0	21	12	26	17	14	0
24 Wedneſ.	21	48	0	21	16	42	16	40	0
February.									
13 Friday.	28	29	0	28	29	58	9	59	0
17 Tueſd.	29	57	0	29	58	10	8	31	0
18 Wed.	30	10	0	30	11	12	8	18	0
24 Tueſd.	32	37	30	32	39	2	5	50	30
25 Wed.	33	1	0	33	2	35	5	27	0
26 Thurſd.	33	24	0	33	25	39	5	4	0
29 Sund.	34	34	30	34	36	19	3	53	30
March.									
13 Saturd.	39	42	0	39	44	7	1	14	0
14 Sund.	40	6	0	40	8	8	1	38	0
16 Tueſd.	40	52	0	4	54	7	2	24	0

The Sunnes true declination.			*The Suns place by obseruation.*			*The Suns place by Prutenick Tables.*			*The difference.*	
Degr.	*Min.*	*Sec.*	*Degr.*	*Min.*	*Sec.*	*Degr.*	*Min.*	*Sec.*	*Min.*	*Sec.*
23	12	26	20	50	15	19	39	0		
23	32	30				27	47	0		
23	34	37				29	50	0		
23	24	32	5	32	0	5 ♑	56	0	24	0
23	18	29	7	34	0	7	58	0	24	0
23	14	27	8	39	45	8	59	0	19	15
22	58	20	12	5	50	12	3	0	2	50
22	16	0	18	19	15	18	9	0	10	15
21	57	53	20	26	0	20	11	0	15	0
21	38	42	22	28	0	22	14	0	14	0
20	17	2	29	42	45	29	22	0	20	45
19	51	20	I ♒	41	13	I ♒	23	0	18	13
19	22	36	3	46	34	3	25	0	21	34
17	15	34	11	59	4	11	32	0	27	4
16	41	18	13	59	30	13	30	0	29	30
9	58	2	4 ♓	18	6	3 ♓	40	0	38	6
8	29	50	8	16	22	7	44	30	31	52
8	16	48	8	51	3	8	45	0	6	3
5	48	57	15	18	10	14	45	0	33	10
5	25	25	16	18	8	15	45	0	33	8
5	2	21	17	17	15	16	45	0	32	15
3	51	41	20	17	12	19	45	0	32	12
1	16	7	3 ♈	10	48	2 ♈	39	0	31	48
1	40	8	4	11	2	3	38	0	33	2
2	26	7	6	6	40	5	37	0	29	40

1596 Aprill.	The Sunnes Apparent height.			The Sunnes True height.			The Sunnes apparent declination.		
Day.	Degr.	Min.	Sec.	Degr.	Min.	Sec.	Degr.	Min.	Sec.
20 Tuesd.	53	23	0	53	24	48	14	55	0
24 Saturd.	54	35	0	54	36	44	16	7	0
25 Sund.	54	51	30	54	53	13	16	23	30
26 Mond.	55	8	30	55	10	13	16	40	30
28 Wed.	55	41	0	55	42	41	17	13	0
29 Thursd.	55	57	0	55	58	36	17	29	0
May.									
4 Tuesd.	57	13	0	57	14	39	18	45	0
11 Tuesd.	58	45	30	58	47	5	20	17	30
Iune.									
15 Tuesd.	61	54	0	61	55	25	23	26	0
18 Friday.	61	47	0	61	48	25	23	19	0
Iuly.									
24 Saturd.	55	56	0	55	57	41	17	28	30
27 Tuesd.	55	8	0	55	9	43	16	40	0
29 Thursd.	54	34	0	54	35	44	16	6	0
30 Friday.	54	17	0	54	18	46	15	49	0
31 Saturd.	54	0	0	54	1	46	15	32	0
August.									
10 Tuesd.	50	51	0	50	52	54	12	23	0
13 Friday.	49	50	30	49	52	26	11	22	30
16 Mond.	48	48	0	48	49	58	10	20	0
21 Saturd.	47	1	30	47	3	33	8	33	30
30 Mond.	43	41	0	43	43	4	5	13	0
31 Tuesd.	43	17	30	43	19	35	4	49	30
September.									
5 Sund.	41	22	30	41	24	37	2	54	30
6 Mond.	40	59	0	41	1	7	2	31	0
7 Tuesd.	40	36	0	40	38	7	2	8	0
8 Wed.	40	12	30	40	14	38	1	44	30

The Sunnes true declination.			The Suns place by observation.			The Suns place by Prutenick Tables.			The difference.	
Deg.	Min.	Sec.	Deg.	Min.	Sec.	Deg.	Min.	Sec.	Min	Sec
14	56	48	10 ♉	15	13	9 ♉	51	0	24	13
16	8	44	14	9	40	13	44	0	25	40
16	25	13	15	5	20	14	42	0	23	20
16	42	13	16	3	42	15	40	0	23	42
17	14	41	17	57	45	17	36	0	21	45
17	30	36	18	55	10	18	34	0	21	10
18	46	39	23	45	4	23	24	0	21	4
20	19	5	♊	27	0	♊	8	0	19	0
23	27	25	4 ♋	14	0	3 ♋	39	0	35	0
23	20	25	6	58	40	6	31	0	27	40
17	29	41	11 ♌	8	11	10 ♌	56	0	12	11
16	41	43	13	58	3	13	49	0	9	3
16	7	44	15	53	40	15	44	0	9	40
15	50	46	16	50	10	16	42	0	8	10
15	33	46	17	45	3	17	39	0	6	3
12	24	54	27	24	24	27	17	0	7	24
11	24	26	♍	17	48	♍	11	0	6	48
10	21	58	3	12	17	3	5	0	7	17
8	35	33	8	1	5	7	55	0	6	5
5	15	4	16	44	40	16	40	0	4	40
4	51	35	17	44	47	17	38	30	6	17
2	56	37	22	36	26	22	31	0	5	26
2	33	7	23	35	43	23	30	0	5	43
2	10	7	24	33	40	24	28	0	5	40
1	46	38	25	32	38	25	27	0	5	38

1596 September.	The Sunnes Apparent height.			True height.			The Sunnes ap. parent declination.		
Day.	Deg.	Min.	Sec.	Deg.	Min.	Sec.	Degr.	Min.	Sec.
13 Mond.	38	16	0	38	18	1	0	12	0
14 Tuesd.	37	52	0	37	54	1	0	36	0
25 Saturd.	33	34	30	33	36	10	4	53	30
27 Mond.	32	48	0	32	49	34	5	40	0
October.									
4 Mond.	30	9	0	30	10	12	8	19	0
Novemb.									
2 Tuesd.	20	35	0	20	33	7	17	53	0
5 Frid.	19	47	30	19	45	14	18	40	30
1597 January.									
25 Tuesday.	22	19	0	22	17	57	16	9	0
29 Saturd.	23	34	0	23	33	32	14	54	0
March.									
11 Frid.	38	49	0	38	51	4	0	21	0
12 Saturd.	39	13	0	39	15	4	0	45	0
13 Sund.	39	36	30	39	38	36	1	8	30
14 Mond.	40	0	0	40	2	8	1	32	0
15 Tuesd.	40	23	0	40	25	8	1	55	0
16 Wednes.	40	46	30	40	48	37	2	18	30
20 Sund.	42	21	30	42	23	36	3	53	30
21 Mond.	42	44	0	42	46	5	4	16	0
Aprill.									
8 Friday.	49	21	30	49	23	27	10	53	30
10 Satur.	56	9	0	56	10	41	17	41	0
May.									
2 Mond.	56	40	0	56	41	40	18	12	0
June.									
9 Thursd.	61	57	0	61	58	25	23	29	0
11 Saturd.	61	58	0	61	59	25	23	30	0

The Sunnes true declination.			The Suns place by observation.			The Suns place by Prutenick Tables.			The difference.	
Degr.	Min.	Sec.	Degr.	Min.	Sec.	Degr.	Min.	Sec.	Min.	Sec.
0	9	59	0 ♎	25	0	0 ♎	21	0	4	0
0	33	59	1	25	10	1	19	30	5	40
4	51	50	12	15	52	12	9	0	6	52
5	38	26	14	15	18	14	8	0	7	18
8	17	48	21	11	35	21	3	0	8	35
17	54	53	20 ♏	24	41	20 ♏	3	0	21	41
18	42	46	23	29	30	23	4	0	25	30
16	10	3	15 ♐	45	53	17 ♐	20	0	25	53
14	54	28	19	52	9	19	22	0	30	9
0	23	4	0 ♑	57	48	0 ♑	25	0	32	48
0	47	4	1	57	55	1	25	0	32	55
1	10	36	2	56	58	2	24	0	32	58
1	34	8	3	56	0	3	23	0	33	0
1	57	8	4	53	45	4	23	0	30	45
2	20	37	5	52	50	5	22	0	30	50
3	55	36	9	52	45	9	19	0	33	45
4	18	5	10	49	50	10	18	0	31	50
10	55	27	28	20	43	27	57	0	23	43
17	42	41	19 ♉	39	22	19 ♉	18	0	21	22
18	13	40	21	35	48	21	14	0	21	48
23	30	25	27 ♊	50	0	27 ♊	41	0	9	0
23	31	25	29	24	0	29	35	0	11	0

1597 Iune.	The Sunnes Apparent height.			The Sunnes True height.			The Sunnes apparent declination.		
Day.	Degr.	Min.	Sec.	Degr.	Min.	Sec.	Degr.	Min.	Sec.
12 Sund.	61	58	0	61	59	25	23	30	0
13 Mond.	61	57	30	61	58	55	23	29	30
19 Sund.	61	46	0	61	47	25	23	18	0
Iuly.									
4 Mond.	60	12	30	60	14	0	21	44	30
5 Tuesd.	60	3	30	60	5	0	21	35	30
6 Wed.	59	54	0	59	55	30	21	26	0
8 Friday.	59	34	0	59	35	31	21	6	0
24 Sund.	56	1	30	56	3	11	17	33	30
26 Tuesd.	55	30	0	55	31	42	17	2	0
Auguſt.									
3 Wed.	53	11	0	53	12	48	14	43	0
9 Tuesd.	51	16	0	51	17	53	12	48	0
Septemb.									
22 Thurſd.	34	50	0	34	51	51	3	38	0
30 Friday.	31	44	30	31	45	55	6	43	30
October.									
6 Thurſd.	29	29	0	29	30	6	8	59	0
12 Wed.	27	19	0	27	19	45	11	9	0
14 Friday.	26	36	30	26	37	5	11	51	30
24 Mond.	23	16	0	23	15	23	15	12	0
27 Thurſd.	22	22	0	22	20	50	16	6	30
29 Saturd.	21	46	0	21	44	41	16	42	0
Nouemb.									
3 Thurſd.	20	24	0	20	22	2	18	4	0
7 Mond.	19	21	30	19	19	0	19	6	30
22 Tuesd.	16	24	0	16	20	5	22	4	0

The Sunnes true declination.			The Suns place by obseruation.			The Suns place by Prutenick Tables.			The difference.	
Degr.	Mi.	Sec.	Degr.	Min.	Sec.	Degr.	Min.	Sec.	Min.	Sec.
23	31	25	0♋	36	0	0♋	33	0	3	0
23	30	55	1	35	0	1	30	0	5	0
23	19	25	7	17	20	7	14	0	3	20
21	46	0	21	43	0	21	33	0	10	0
21	37	0	22	38	18	22	31	0	7	18
21	27	30	23	34	42	23	28	8	6	42
21	7	31	25	27	11	25	23	0	4	11
17	35	11	10♌	48	8	10♌	42	0	6	8
17	3	42	12	41	14	12	37	0	4	14
14	44	48	20	22	41	20	18	0	4	41
12	49	53	26	11	36	26	5	0	6	36
3	36	9	9♎	3	26	8♎	57	0	6	26
6	42	5	16	59	57	16	51	0	8	57
8	57	54	22	58	13	22	48	0	10	13
11	8	15	28	56	34	28	46	0	10	34
11	50	55	0♍	57	28	0♍	45	0	12	28
15	12	37	11	5	41	10	46	0	19	41
16	7	10	14	4	23	13	46	0	18	23
16	43	19	16	7	30	15	47	0	20	30
8	5	58	21	6	26	20	48	0	18	26
16	9	0	25	16	16	24	50	0	26	16
22	7	55	10♑	42	36	10	1	0	41	36

Chap. XX.

The finding of the Sunnes Apogæum and eccentricitie out of the former obſeruations.

NOw by the whole courſe of theſe obſeruations, it manifeſtly appeareth, that the declinations ſet down in the regiments of the Sunne, that are, and haue bin hitherto ordinarily vſed by our ſea men, do for the moſt part notably erre from the truth of the heauens. Which errors as they may moſt truly be corrected by obſeruatiõ only in thoſe daies wherein certaine obſeruation was made: ſo for finding out the declinations of the middle daies betweene the obſeruations, I thought it the beſt way, firſt to make the Ephemerides of the Sunne hereafter following, agreeable to the former obſeruations, and then to finde out the declinations anſwerable to the places of the Sunne for euery day of foure yeeres together, becauſe that after that number of yeeres the ſame places of the Sunne, and the ſame declinations returne againe without ſenſible error, which alſo by a certaine æquation may be corrected: and for the eaſier finding out of this æquation, I haue continued theſe Tables for one yeere more, making them for fiue yeeres, and ſo including two leape yeeres, by the difference of which yeeres we may eaſily find the ſaid æquation, by meanes whereof theſe Tables may be made ſeruiceable for many yeeres.

Firſt therefore for making theſe Ephemerides, it is needfull to know the time of the Sunnes entrance into

into certaine principall points of the Zodiack: as also the time of the Sunnes continuance in the arches of the Zodiack conteined betweene those points, whereby the proportion of the Sunnes motion may geometrically bee found out, his eccentricitie and place of his apogæum being hereby knowne.

To know the time of the Suns comming to any point of the ecliptick, it is best to obserue exactly the meridian altitude of the Sunne, not only the same day wherein hee is like to enter into the point desired, but euery day also, for two or three daies together both before and after that day, that both by the testimonie of so many obseruations compared together, you may haue the more assured truth: as also, that if the day you most desire fall not out to be so cleere as you would wish, you may notwithstanding, by the obseruations of the daies going before, and following after, or either of them, obtaine your desire.

To know the time of the Sunnes comming to any point of the Ecliptick.

Hauing thus obserued the meridian altitudes of the Sunne, and thereby also found his declinations for euery one of those daies wherein you obserued, you shall easily know also the true place of the Sun in euery each one of the same daies, with helpe of the former table of the declination of euery minute of the ecliptick, in such sort as before was declared, when I shewed the vse of that Table.

Now if it fall out so happily, that both the day be cleere, when the Sun entreth into the defired point of the ecliptick, and that the place of the Sunne answerable to the declination of that day, be all one with the point desired, you haue alreadie that you

ſought for, without any more adoe, *viz.* that the Sunne entreth that day at noone into the point deſired. Otherwiſe ſubtract the obſerued place of the Sunne, next before the point deſired out of the obſerued place of the Sun, next following that point, and the remainder ſhall ſhew you the true motion of the Sunne, anſwerable to the time between thoſe obſeruations. Subtract alſo the former place of the Sunne, from his place in the point deſired, and note the difference: for as the former remainder (that is the apparent motion of the Sunne between the obſeruations) is to the time betweene thoſe obſeruations: ſo is this difference to the time betweene the firſt obſeruation, and the Sunnes entrance into the point deſired.

Example of the firſt: I deſired to know the time of the Sunnes entrance into 17 degrees, 0 min. of ♌ in the yeere 1595. I obſerued therefore (at London) the apparent height of the Sunne at noone, the 31 of Iuly the ſame yeere, and found it to be 54 degrees, 14 minutes, out of which his true height (corrected by his parallax) was found to be 54 degr. 15 min. 46. ſec. whereby his declination was gathered to be 15. degrees, 47 minutes, 46 ſec. and conſequently his place in 17 degrees, 0 minutes of ♌ that day at noone.

Example of the ſecond: admit the yeere following 1596 you would know the time of the Sunnes entrance into the midſt of *Taurus*. Hauing therfore to this end obſerued the apparent meridian altitudes of the Sunne, the 24, 25, and 26 daies of April, in that yeere (within the ſpace of which daies I am

ſure

ſure the Sunne muſt needs be in that point) to bee 54 degrees, 35 minutes, 54 degrees, 51 min. $\frac{1}{2}$, 55 degrees, 8 min. $\frac{1}{2}$, and conſequently the true heights 54 degr. 36 min. 44 ſec. 54 degr. 53 min. 13 ſec. 55 degrees, 10 min. 13 ſec. and out of theſe the true declinations 16 degr. 8 min. 44 ſec. 16 degr. 25 min. 13 ſec. 16. degr. 52. min. 13. ſec. Hereby I found the true places of the Sun the ſame daies to be 14 deg. 9 min. 40 ſec. of *Taurus*, 15 degr. 5 min. 20 ſec. of *Taurus*, 16 deg. 3 min. 42 ſec. of *Taurus*. Subtracting therfore 14 degr. 9 min. 40 ſec. of *Taurus*, (that is, the place of the Sunne the 24 day) out of 15 degr. 5 min. 20 ſec. of *Taurus*, the place of the Sun the 25 day) the remainder ſhall be 55 min. 40 ſec. which is the true motion of the Sunne, betweene the 24, and 25 daies at noone, that is, the diurne motion of the Sunne at that time. Subtracting alſo 14 degr. 9 min. 40 ſec. of *Taurus*, out of 15 degr. 0 min. of *Taurus*, the differēce is 50 min. 20 ſec. Now as 55 min. 40 ſec. is to 50 minutes, 20 ſec. ſo are 24 houres, to 21 houres, 42 min. and 2 ſec. It appeareth therefore by ſubtracting 21 houres, 42 min. 2 ſec. out of 24 houres, that the Sun ſhould enter into the midſt of *Taurus*, the 25 day, about two houres and almoſt 18 min. before noone, that is, at nine a clock, and 42 minutes.

Now ſuppoſing I had not, or could not haue obſerued the 25 day, I may notwithſtanding finde the time of the Sunnes entrance into the midſt of *Taurus*, by the obſeruations of the 24 and 26 daies after this maner: Subtract 14 degr. 9 min. 40 ſec. of *Taurus*, out of 16 degr. 3 min. 42 ſec. of *Taurus*, the remainder will be one degr. 54 min. 2 ſec. that is the

motion

motion of the Sunne for two daies, betweene the 24 and 26 daies at noone. Therefore as 1 degr. 54 min. is to 48 houres: so are 50 min. 20 sec. (that is the difference of the place of the Sunne the 24 day from the midst of *Taurus*, found out as before) to 21 houres and 12 min. almost. So as hereby it seemeth the Sunne should enter into the midst of *Taurus* the 25 day about two houres and 48 minutes before noone, that is, at nine of the clock and 12 minutes.

But if it so fall out that you do not or cannot obserue, both before and after the time of the Sunnes comming to the point desired, (as suppose I could not haue obserued the 24 day, but only the 25 and 26 daies, in both which daies the Sunne is gone past the point desired) notwithstanding you may obtaine your desire thus: Subtract 15 degr. 5 min. 20 sec. *Taurus*, (the place of the Sunne the 25 day) out of 16 degr. 3 min. 42 sec. *Taurus* (the place of the Sun the 26 day) there will remaine 58 min. 22 sec. the diurne motion of the Sunne betweene the noone-tides of the 25 and 26 daies. Now because that on the 25 day at noone the Sunne was gone 5 min. 20 sec. past the point desired: therefore as 58 min. 20 sec. are to 24 houres, so are 5 min. 20 sec. to 2 houres 12 min. almost. By this account then the Sun should enter into the midst of *Taurus* the 25 day, 2 houres and about 12 min. before noone: that is, at nine of the clock and 48 minutes. Neither ought that small difference that appeareth betweene these accounts to be greatly regarded, which amounts not to so much as halfe an houre, in which time the motion of

of the Sunne is little aboue a minute, and the declination of the Sunne in that part of the Zodiack cannot alter ſo much as $\frac{1}{3}$ of a minute, which is ſo ſmall, as can by ſenſe very hardly be obſerued or diſcerned. Neither yet ought that little difference of a minute or two that appeareth betweene the diurne motions of the Sunne, found by obſeruation, greatly moue any man (in that by the firſt and ſecond obſeruations the diurne motion ſhould be almoſt 56 min. by the firſt and third 57 min. by the ſecond and third 58 min. and more) the greateſt of which differences may almoſt ariſe by erring but one halfe minute only, in taking the height of the Sun; which error is in a manner altogether inſenſible, and will be eaſily pardoned by them that haue or ſhall accuſtome themſelues to make the like obſeruations, when beſides their owne experience they ſhall find that they which haue moſt excelled in this Art, as *Tycho Brahe de recentioribus ætherei mundi phænom. lib. 2 cap. 10. part 1. Copern. Reuol. libr. 4. cap. 21.* and *Ptolemee* himſelfe in all his Catalogue of the fixed ſtarres, *Almageſt lib. 7. cap. 5.* when they ſhall finde (I ſay) that euen theſe Princes in Aſtronomie, ſo greatlie exerciſed in obſeruations, haue accounted an whole minute or two, hardly ſenſible: *Ptolemee* alſo in his *Almageſt* contenting himſelfe, for the moſt part, to haue ſet down the places of the fixed ſtarres to ſixth parts of degrees, and very ſeldome comming to twelfth parts, thinking it ſufficient (as it may ſeeme by the perpetuall courſe of that Catalogue) to come within fiue or ten minutes of the truth.

But to returne againe to that from whence wee haue

haue a little digreſſed. After this manner now ſhewed, we found the time of the Sunnes entrance into the beginning of ♈ and ♎, and into the midſt of ♉, ♌, ♏, and ♒, as into places ſeruing moſt fitly for finding out of the Suns eccentricitie and apogeum: following alſo herein the example of *Copernicus, lib.3.cap.16.Reuol.* who well perceiuing how hard, yea rather impoſſible a thing it is, to finde by obſeruation the time of the Sunnes entrance into the ſolſtitiall points (where the meridian altitudes, and declinations of the Sunne continue almoſt the ſame, without any ſenſible difference for two or three daies together) choſe rather the parts of the Zodiack alreadie mentioned, where the place of the Sunne may more truly be knowne by reaſon of the quicker altering of his declination, the difference thereof in the ſpace of 24 houres amounting to more then 17 min. The times therefore of the Suns comming to the foreſaid points in the yeeres 1594, 1595, 1596, 1597, wee found to be ſuch as are ſet downe in the table following.

	1594			1595			1596			1597				
	Da.	Ho.	Mi.	Da.	Ho.	Mi.	Da.	Ho.	Mi.	Da.	Ho.	Mi.	Sig.	De.
Ian.				24	17	35	25	0	7	24	5	54	♒	15
Mar.				10	13	26	9	18	43	10	0	37	♈	0
April.				25	16	50	24	21	47	25	3	54	♉	15
Iuly.	28	15	35	28	20	4	28	1	43	28	9	56	♌	15
Sept.	13	2	45	13	7	39	12	13	48	12	19	15	♎	0
Octob.	28	5	46	28	9	36	27	15	23	272	1	50	♏	15

Hereby the times of the Sunnes continuance in the arks of the Zodiack betwixt thoſe points, as alſo the

the arkes of the eccentrick anſwerable to thoſe times, were more eaſily found then that it ſhould now be needfull for me to be further tedious, in ſetting downe the manner of finding the ſame, wherein notwithſtanding there may ſome difference of an houre or two ſometimes appeare, by comparing together thoſe times in ſeuerall yeeres: yet this error being ſuch as may ariſe by miſſing little more then one minute in one obſeruation: or little more then halfe a minute in two obſeruations of the meridian altitudes of the Sunne (one obſeruation being made when the Sunne is about the beginning of the arke, the other when he is about the ending thereof) I make no doubt, but that it ſhall at the leaſt be fauourably cenſured by them that haue acquainted themſelues with ſome practiſe of obſeruing: wherein hee ſhall (in my opinion) quit himſelfe meetly well, who neither through imperfection of ſenſe, either in making or diuiding, or in rectifying, or in vſing his inſtrument, and euery part thereof: nor through the difficultie of noting preciſely the edges of the ſhadow of the vpper ſight falling vpon the nether: (the limits or bounds of which ſhadow are but a confuſed mixture (as it were) of light and darkneſſe, or elſe a meane equally compounded of them both, which can no better bee diſcerned then by gheſſing:) nor yet by refraction of the Sunbeames through the thicknes of the aire, eſpecially when the Sunne is in the Southerly ſemicircle of the Zodiack, which refraction admitteth ſome alteration, according to the diuerſitie of the raritie or denſitie of the vapours in the aire interpoſed betwixt

twixt our ſight and the Sunne; he ſhall (I ſay) quit himſelfe well, that neither by one, nor ſome, nor all theſe, ſhall miſſe a minute and more ſometimes in obſeruing the meridian altitude of the Sun: whereby if error be committed both at the beginning and ending of the foreſaid arkes (eſpecially of thoſe arks that are conteined betweene the midſt of *Taurus* and *Leo*, of *Leo* and *Scorpio*, of *Scorpio* and *Aquarius*, of *Aquarius* and *Taurus*) the place of the Sun found by ſuch obſeruation, may bee more or leſſe then truth by three or foure minutes, and both errors together may amount to ſix or eight min. error in the motion of the Sunne, whereof may follow two or three houres error in the time of the Suns abiding in one of thoſe arkes.

Out of the former table I found (by the obſeruations of the two laſt yeeres eſpecially) that the time of the Sunnes reuolution through the Zodiack in our time, is 365 daies, 5 houres, and about 48 min. Alſo the time of the Suns continuance in the Northerly ſemicircle of the Ecliptick, from the beginning of *Aries* to the beginning of *Libra*, to be 186 daies, 18 houres, and about one halfe: and conſequently in the Southerly ſemicircle from *Libra* to *Aries*, 178 daies, 11 houres, 18 minutes: whereby the arkes of the Sunnes eccentrick, anſwerable to thoſe ſemicircles, appeared to be 184 degrees, 5 min. 25 ſec. from *Aries* to *Libra*, and 175 degrees, 54 min. 35 ſec. from *Libra* to *Aries*.

Therefore becauſe the place of the Sunne being at, or neere the æquinoctiall points, is moſt certainly knowne (his meridian altitude and declination altering

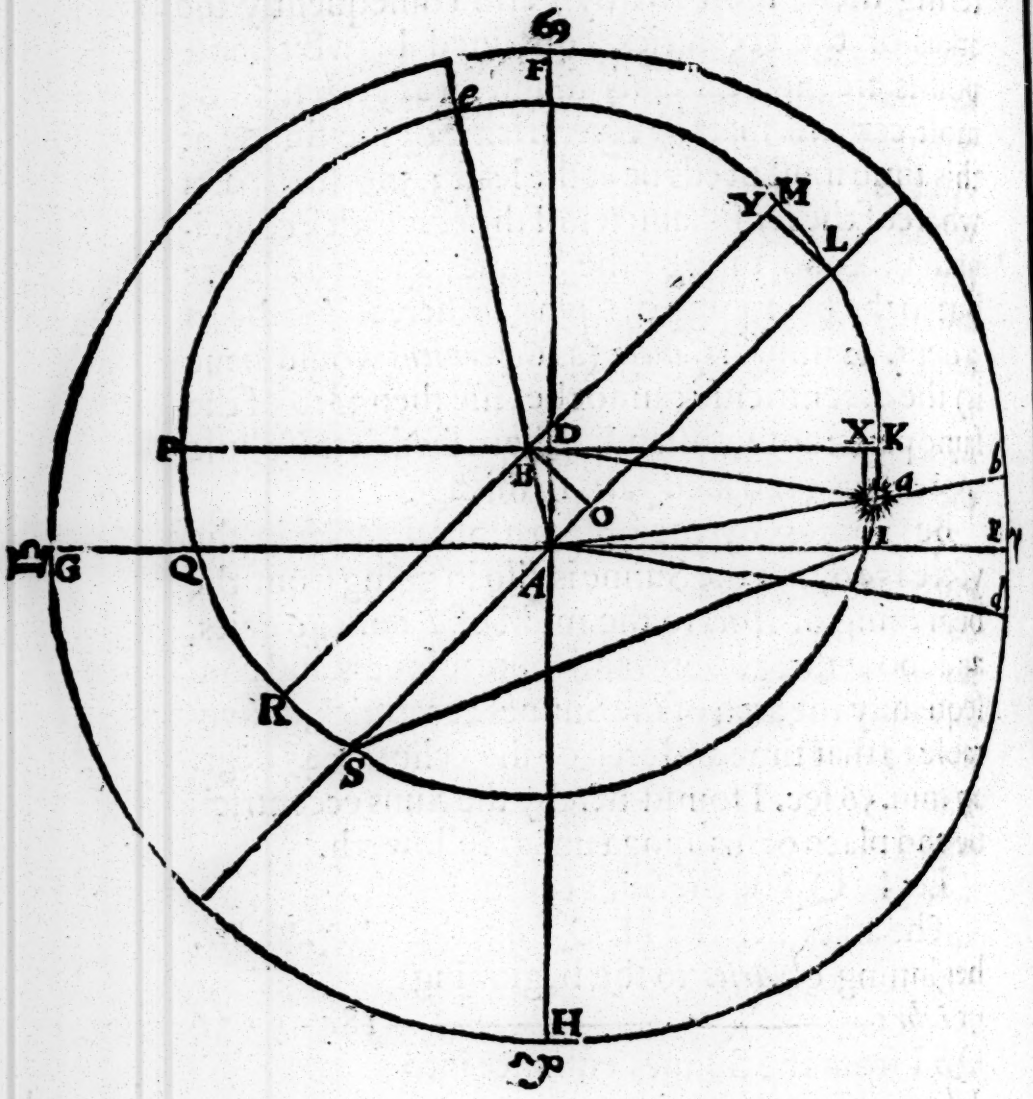
tering there moſt ſwiftly) and conſequently the arkes of the eccentrick contained betwixt thoſe points, are moſt certainly found: it appeareth to be moſt certaine that the eccentricitie of the Sunne at this time muſt needs be at the leaſt 3,569 ſuch parts whereof the ſemidiameter of the eccentrick containeth 100,000, though the Sunnes apogæum were but in the beginning of *Cancer*: whereas if it be in 9 degr. 22 min. of *Cancer* (as *Copernicus* would haue it) the eccentricitie cannot be leſſe then 3616 of the ſame parts; notwithſtanding he maketh it to be little more then 3220 ſuch parts in this age.

But finding by the obſeruations I tooke in the yeere 1596, that the Sunne is alſo in going from the beginning of *Aries* to the midſt of *Taurus* 46 daies, and about three houres and foure minutes, and conſequently the arch of the Sunnes eccentrick, anſwerable to that time and arch of the ecliptick 45 degr. 27 min. 56 ſec. I found hereby the Suns eccentricitie and place of his apogæum, as followeth.

Let I e Q S be the Suns eccentrick:

	Deg. Mi. Sec.
The arkes thereof I E Q from the beginning of *Aries* to the beginning of *Libra*	184 - 5 - 26
Q S I from the Sunnes entrance into *Libra* to his entrance into *Aries*	175 - 54 - 34
and I L from the beginning of *Aries* to the midſt of *Taurus*	45 - 27 - 56
the halfe whereof is the angle I S L	22 - 43 - 58.
Alſo the angle I A L from the beginning of *Aries* to the 15 of *Taurus*	45 - 0 - 0
The complement whereof to a ſemicircle is the angle I A S	135 - 0 - 0

which



Deg. Mi. Sec.

which added to the angle I S A, makes 157-43-58
the complement whereof to a semi-
circle is the angle A I S ——— 22-16-2
the double wherof is the arch of the ec-
centrick S Q ——— 44-32-4:
which taken out of Q S I ——— 175-54-34

there

Deg.Mi.Sec.

there remaineth the arch S I ——— 131-22-30
the ſubtenſe whereof S I is ——— 18,226,268
whereof the whole ſine conteineth — 10,000,000
And this arch added to I L, maketh the
whole arch S I L ——— 176-50-26
the cõplement hereof to a ſemicircle is — 3-9-34
and the halfe of this complement is the
arch L M ——— 1-34-47
the ſine whereof is the line O B ——— 275,678
Moreouer, the halfe of the arch S I L is — 88-25-13
the ſine whereof is the line S A O ——— 9,996,199

Now in the triangle S I A, becauſe the ſides are proportionall to the ſines of the oppoſite angles: therefore as the ſine of the angle S A I — 7,071,068, is to the ſide S I ——— 18,226,268: ſo is the ſine of the angle S I A ——— 3,789,268, to the ſide S A ——— 9,842,653: which takẽ out of S A O, there is left A O 229,044 which hath the ſame proportion to — 10,000,000 that the right line O B ——— 275,678 hath to ——— 12,036,028 which is the tangent of the angle B A O — 50-16-42 the diſtance of the Suns apogæum from the midſt of *Taurus*; that is, from the beginning of *Cancer*; ——— 5-16-42 which, to auoid ſcrupuloſitie, we wil make 5-17-0 the ſine whereof ——— 7,692,137 is to the whole ſine ——— 10,000,000 as the right line O B ——— 275,678 is to B A the Sunnes eccentricitie ——— 358,388 wherof B E, the radius of ỳ eccentrick, is 10,000,000

Which may yet alſo be more eaſily found by the Tetragonicall table, or table of Rootes and ſquares, for taking A O and O B to be 2290, and 2757, their ſquares will be 5,244,100, and 7,601,049; which added together make 12,845,149, the ſquare roote or ſide whereof is 3584, the Sunnes eccentricitie, in ſuch parts whereof the ſemidiameter of the eccentrick B e conteineth 100,000, agreeing exactly with the Sunnes eccentricitie, found by *Tycho Brahe Progymnaſmat. pag. 26.*

The ſame may alſo be further confirmed thus: We haue found the arch of the Sunnes eccentrick from the beginning of *Aries* to the beginning of

	Deg. Mi. Sec.
Libra, to be	184-5-26,
the exceſſe wherof aboue a ſemicircle is	4-5-26,
the halfe of this is the arch I K	2-2-43,
the ſine whereof I X (equall to A D) is	356,892
(whereof the ſemidiameter of the eccentrick is	10,000,000)

which ſhould be the Suns eccentricitie, if his apogæum were in the beginning of *Cancer*. But hauing found that the Suns apogæū is about 5 deg. 17 min. of *Cancer*; therfore as the whole ſine — 10,000,000 is to the ſecant of 5 degr. 17 min. — 10,042,667 ſo is AD in the right angled triangle ADB 356,892 to A B the eccentricitie of the Sun — 358,414, which hath not any ſenſible difference from that we found before.

But the place of the Sunnes apogæum, found by the foreſaid obſeruations, differeth from *Tycho* twentie minutes (if we adde to his place of the apo-

gæum

gæum of the Sunne 7 minutes, for the motion of the Sunnes apogæum in the tenne yeeres ſpace betwixt his obſeruation and mine). All which difference notwithſtanding may ariſe by erring little more then halfe a quarter of a minute in obſeruing the Suns height about the midſt of *Taurus*. Which error although it be ſo ſmall that it may worthily be neglected, for whether of them ſoeuer you follow, either his (apogæum) or mine, for the making of the Ephemerides and tables enſuing, there cannot hereof ariſe any ſuch diſagreement as can by ſight be diſcerned: yet in that ſmall difference that is, (though inſenſible) I ſhal not vnwillingly yeeld vnto him, conſidering with how great preparation, coſt, skill, diligence, and circumſpection euery way he went about this buſineſſe: as all they that haue any iudgement and vſe of obſeruation will eaſily grant. I ſay therefore not building only vpon his authoritie (though in this kinde it be greater then any others, yet knowne to the world) that (following the ordinarie receiued hypotheſis of an eccentrick, for ſaluing the Sunnes apparent inequalitie of motion) the Suns eccentricitie & place of his apogæũ, ſet downe by *Tycho*, as before we haue ſhewed, are in this our age very agreeable to truth, and without al ſuch error as can by ſenſe be diſcerned. And as for ẏ difference that ſeemeth to be betwixt vs, being ſo ſmall and inſenſible; ſo farre ought it to be from breeding doubtfulnes in any, that it may rather make not a little for the confirmation of the truth both of his and my obſeruations; ſo as none ſhall need to make ſcruple of the certeintie and infallibi-

litie of those tables of the Suns declination, which for the Nauigators vse shall out of these grounds be gathered and diduced.

Chap. XXI.

The middle motion of the Sunne, corrected out of the former obseruations.

THE eccentricitie therefore and apogeum of the Sun being thus knowne, together with his true place (which by so exact obseruation as we could in the yeere 1597, the 11 of March at noone, we found to be 0 degr. 57 min. 48 sec. of *Aries:*) his middle motion from the beginning of *Aries* was also easily found after this manner:

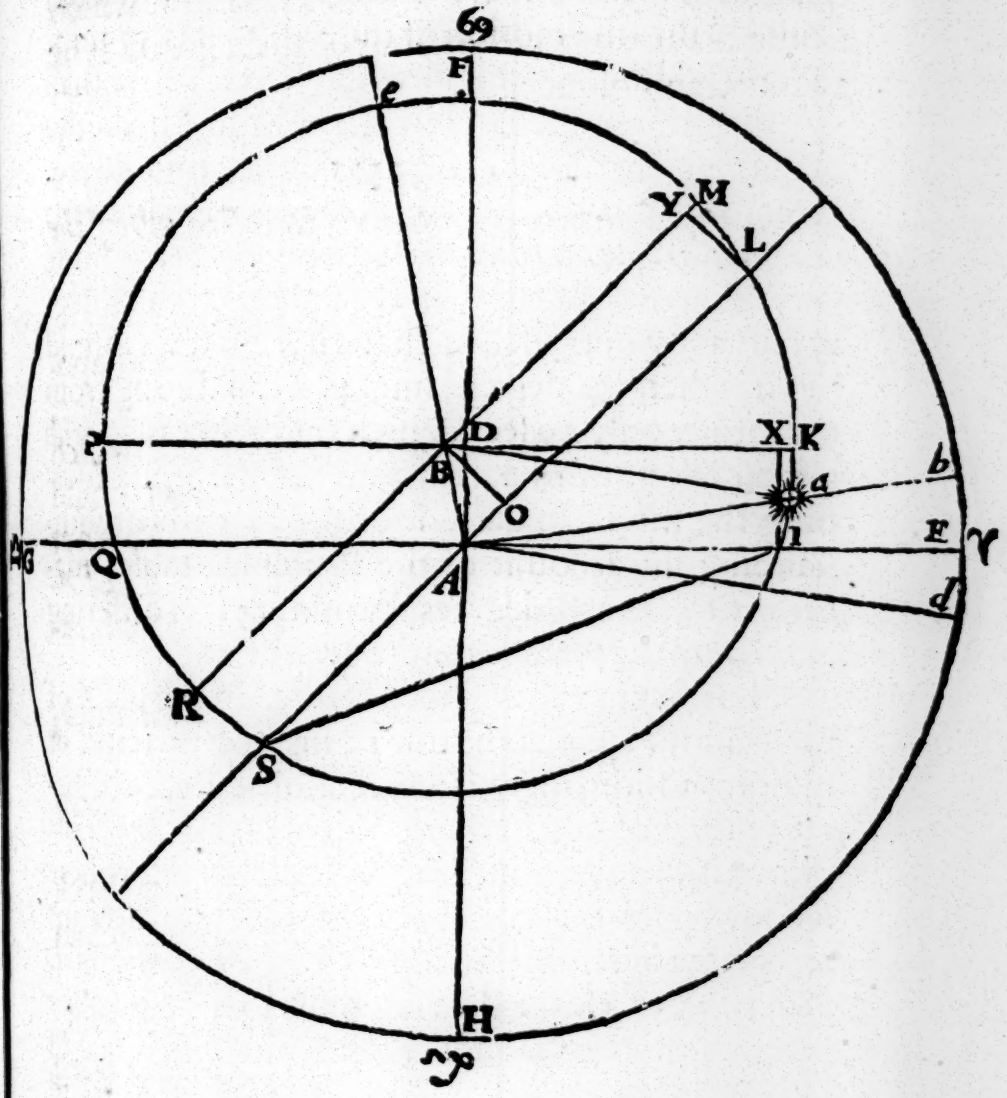
Let *a* be the place of the Sunne in his eccentrick; *b* the Suns true place in the Zodiack.

B *a* a line drawne from the center of the eccentrick to the center of the Sunne.

A *d* a line drawne frō the center of the ecliptick parallel to B *a*, shewing the middle place of the Sun in the Zodiack.

A B, a line drawne frō the center of the ecliptick, by the center of the Sunne to the Zodiack, shewing the true place of the Sunne.

Therefore the angle B A D being 5 degr. 37 min. and consequently the angle B A I 95 degr. 37 min. because D A I is a right angle: the angle *a* A I, found by obseruation to be 0 degrees, 57 min. 48 seconds, being subtracted from the angle B A I, there shall remaine the angle B A *a* in the triangle B A *a* 94 degr. 39. min.



39 min. 12 ſec. and two ſides alſo of the ſame triangle being giuen, *a* B 100, 000 parts, and B A 3584 of the ſame parts, therefore by the doctrine of triangles, the angle B *a* A equall to *a* A *d* (becauſe B *a*, and A D are parallels) ſhall likewiſe be found to be 2 degrees, 2 min. 52 ſec. (the proſthaphæreſis or æ-

quation of the Sunne at that time, which ſubtracted from E *b* the true motion of the Sun, that is, 57 min. 58 ſec. (adding thereto an whole circle) there ſhall remaine the middle motion of the Sunne from the beginning of ♈, E F G H *d*, 358 degr. 54 min. 56 ſec. According to *Tycho* his tables *Progymnaſmat. part.* 1. *pag.* 59. (if wee account the difference of longitude betweene *London* and *Vraniburg* to be about 11. deg. 15 min. as by our beſt Sea-charts it ſeemeth it ſhould be) it is then 358 degr. 55 min. 45 ſec. differing from the former only 49 ſec. Which difference may ariſe almoſt of one third part of a minute error in obſerving the meridian altitude of the Sun: Notwithſtanding the account of the Prutenick tables maketh it to be 358 degrees, 35 min. 15 ſec. differing from both the former about 20 minutes.

Thus hauing found, that neither in the place of the Sunnes apogæum, nor in his eccentricitie or middle motion, there is any ſenſible difference betwixt the accounts ariſing out of *Tycho Brahe* his obſeruations and mine owne; I haue therefore here ſet downe the tables of the Sunnes middle motions altogether agreeable to thoſe of his; *Progymnaſmat. part.* 1. *pag.* 57. 58. 59. allowing only to his Epochaes ſo much more as is anſwerable to the difference of longitude between the place of his obſeruation and mine, that is, to the Epochaes of the Sunnes middle motion of longitude, 1 min. 52 ſec. anſwering to 45 min. of an houre almoſt, or 11 degr. and ¼, that is, ſo much as the citie of *London* ſeemeth to bee more Weſterly then *Vraniburg*.

EPOCHAES OF THE MIDDLE MOTIONS OF THE SVNS

	Apogæum.				Longitude.					Apogæum.				Longitude.			
Yeares	Si.	P.	Mi.	Se.	St.	P.	Mi.	Se	Yeares	Si.	P.	Mi.	Se.	Sig.	P.	Mi.	Se.
1500	3	4	24	45	9	20	10	52	1625	3	5	58	30	9	20	53	50
1520	3	4	39	45	9	20	20	6	1626	3	5	59	15	9	20	39	30
1540	3	4	54	45	9	20	29	20	1627	3	6	0	0	9	20	25	11
1560	3	5	9	45	9	20	38	35	1628	3	6	0	45	9	21	10	0
1580	3	5	24	45	9	20	47	49	1629	3	6	1	30	9	20	55	40
1600	3	5	39	45	9	20	57	4	1630	3	6	2	15	9	20	41	21
1601	3	5	40	30	9	20	42	44	1631	3	6	3	0	9	20	27	2
1602	3	5	41	15	9	20	28	25	1632	3	6	3	45	9	21	11	51
1603	3	5	42	0	9	20	14	6	*Middle motions in single yeeres vntill 20.*								
1604	3	5	42	45	9	20	58	54									
1605	3	5	43	30	9	20	44	35	1	0	0	0	45	11	29	45	41
1606	3	5	44	15	9	20	30	16	2	0	0	1	30	11	29	31	21
1607	3	5	45	0	9	20	15	56	3	0	0	2	15	11	29	17	2
1608	3	5	45	45	9	21	0	45	4	0	0	3	0	0	0	1	51
1609	3	5	46	30	9	20	46	26	5	0	0	3	45	11	29	47	32
1610	3	5	47	15	9	20	32	7	6	0	0	4	30	11	29	33	12
1611	3	5	48	0	9	20	17	47	7	0	0	5	15	11	29	18	53
1612	3	5	48	45	9	21	2	36	8	0	0	6	0	0	0	3	42
1613	3	5	49	30	9	20	48	17	9	0	0	6	45	11	29	49	22
1614	3	5	50	15	9	20	33	58	10	0	0	7	30	11	29	35	3
1615	3	5	51	0	9	20	19	38	11	0	0	8	15	11	29	20	44
1616	3	5	51	45	9	21	4	7	12	0	0	9	0	0	0	5	33
1617	3	5	52	30	9	20	50	8	13	0	0	9	45	11	29	51	13
1618	3	5	53	15	9	20	35	48	14	0	0	10	30	11	29	36	54
1619	3	5	54	0	9	20	21	29	15	0	0	11	15	11	29	22	35
1620	3	5	54	45	9	21	6	18	16	0	0	12	0	0	0	7	24
1621	3	5	55	30	9	20	52	1	17	0	0	12	45	11	29	53	4
1622	3	5	56	15	9	20	37	39	18	0	0	13	30	11	29	38	45
1623	3	5	57	0	9	20	23	20	19	0	0	14	15	11	29	24	26
1624	3	5	57	45	9	21	8	9	20	0	0	15	0	0	0	9	14

THE SVNS EQVAL MOTION OF LONGITVDE.

In moneths of the common yeere.	S.	D	M.	Se.
Ianu.	1	0	33	18
Febr.	1	28	9	11
Mar.	2	28	42	30
April.	3	28	16	39
May.	4	28	49	58
Iune.	5	28	24	7
Iuly.	6	23	57	26
Aug.	7	29	30	44
Sept.	8	29	4	54
Octob.	9	29	38	12
Nou.	10	29	12	22
Dec.	11	29	45	40

In moneths of the leape yeere.	S.	D.	M.	Se
Ianu.	1	0	33	18
Febr.	1	29	8	20
Mar.	2	29	41	38
April.	3	29	15	48
May.	4	29	49	6
Iune.	5	29	23	16
Iuly.	6	29	56	34
Aug.	8	0	29	53
Sept.	9	0	4	3
Octob.	10	0	37	21
Nou.	11	0	11	31
Dec.	0	0	44	49
In Moneths.				

In daies.	Da	De.	Mi.	Se.
1	0	59	8
2	1	58	17
3	2	57	25
4	3	56	33
5	4	55	42
6	4	54	50
7	6	53	58
8	7	53	7
9	8	52	15
10	9	51	23
11	10	50	32
12	11	49	40
13	12	48	48
14	13	47	57
15	14	47	5
16	15	46	13
17	16	45	21
18	17	44	30
19	18	43	38
20	19	42	47
21	20	41	55
22	21	41	3
23	22	40	12
24	23	39	20
25	24	38	28
26	25	37	37
27	26	36	45
28	27	35	53
29	28	35	1
30	29	34	10
31	30	33	18

In houres.	H	Mi.	S
1	2	28	
2	4	56	
3	7	24	
4	9	51	
5	12	19	
6	14	47	
7	17	15	
8	19	34	
9	22	11	
10	24	38	
11	27	6	
12	29	34	
13	32	2	
14	34	30	
15	36	58	
16	39	26	
17	41	53	
18	44	21	
19	46	49	
20	49	17	
21	51	45	
22	54	13	
23	56	40	
24	59	8	

In houres.

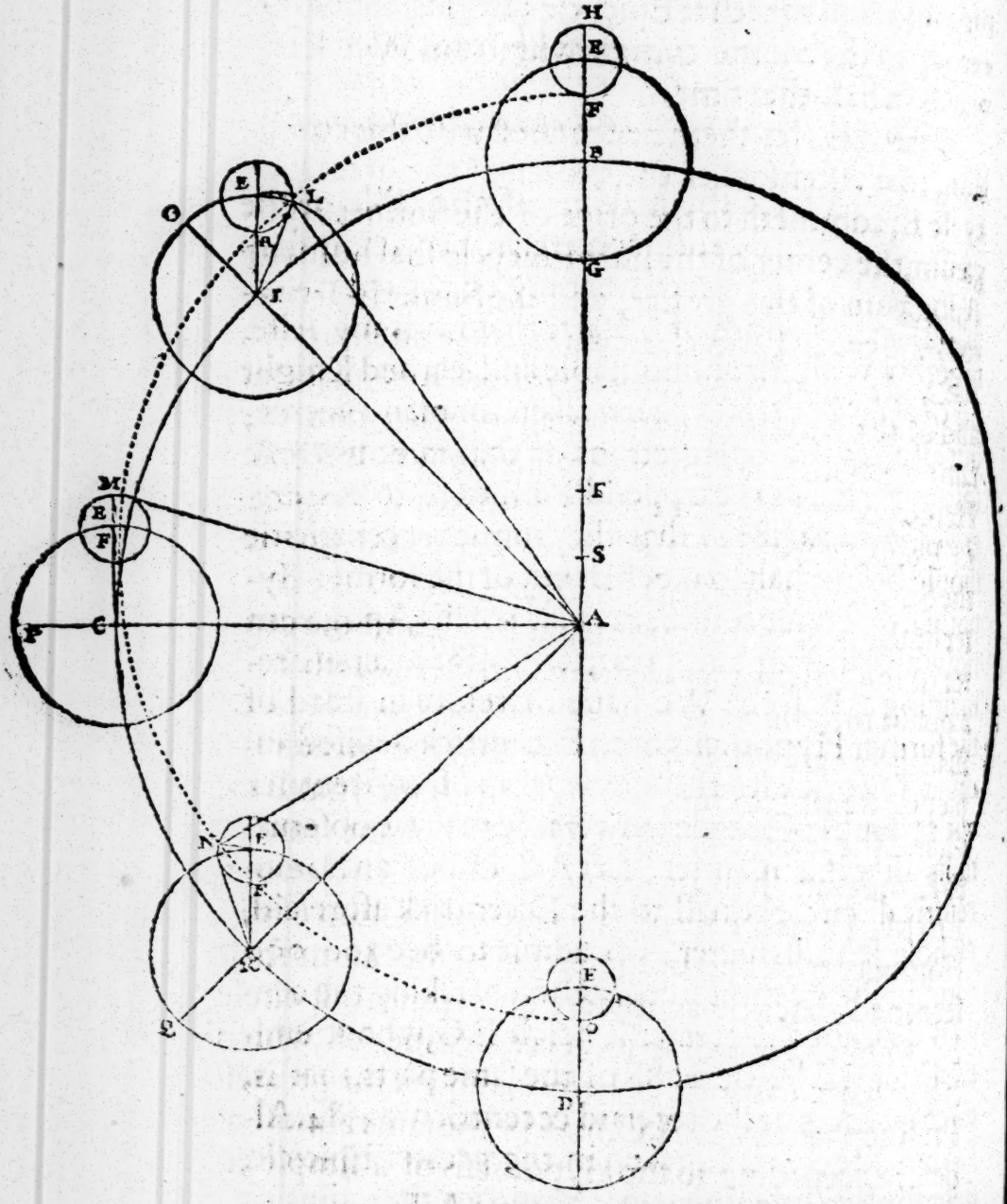
In minutes.	M.	M. S.	M.	M. S.
0	0	0	30	1 14
1	0	2	31	1 16
2	0	5	32	1 19
3	0	7	33	1 21
4	0	10	34	1 24
5	0	12	35	1 26
6	0	15	36	1 29
7	0	17	37	1 31
8	0	20	38	1 34
9	0	22	39	1 36
10	0	25	40	1 39
11	0	27	41	1 41
12	0	30	42	1 43
13	0	32	43	1 46
14	0	34	44	1 48
15	0	37	45	1 51
16	0	39	46	1 53
17	0	42	47	1 56
18	0	44	48	1 58
19	0	47	49	2 1
20	0	49	50	2 3
21	0	52	51	2 6
22	0	54	52	2 8
23	0	57	53	2 11
24	0	59	54	2 13
25	1	2	55	2 15
26	1	4	56	2 18
27	1	7	57	2 20
28	1	9	58	2 23
29	1	11	59	2 25
30	1	14	60	2 28

Chap. XXII.

A new Theorick of the Sunne for the making of the table of the Sunnes Prosthaphæreses following.

BVt for the making of the table of the Suns Prosthaphæreses, because it may be gathered not only out of the obseruations of *Mars*, that both my selfe, together with that honourable and learned Knight Sir *Christopher Heydon*, haue taken for many yeeres; but also by the obseruations of that famous *Tycho* (as appeareth in the appendix annexed to his *Progymnasmata*, *pag.* 821) that the Sunnes eccentricitie should be but half so much, as out of the former Hypothesis we haue found, the place of his Apogæum notwithstanding and greatest Prosthaphæresis remaining as before: We haue therefore in stead of the former Hypothesis of an Eccentrick deuised another Theorick for the Sunne, of an Homocentrick with a double Epicicle answerable to those obseruations after this manner: Let B C D bee an homocentricall circle equall to the Eccentrick aforesaid, (whose semidiameter A B admit to bee 100,000 parts) in the circumference whereof taking the center B, describe the greater Epicicle E G, whose semidiameter E B let be 2688 of the same parts, that is, three quarters of the foresaid eccentricitie 3584. Also vpon the center E, taken in the greater Epicicle, describe the little Epicicle F H, and let the radius or semidiameter thereof E H be 896 such parts, that is, one quarter of the former eccentricitie of the Eccentrick. Let all these circles be moued about their

owne



owne centers equally; the homocentrick carrying about the center of the greater Epicycle from the Weſt Eaſtwards in the time that the Sunne returneth againe to his Apogæum; the greater Epicycle mouing

moving about from East Westward in the same time also, and the lesser Epicycle carrying about the center of the Sunne contrariwise from West Eastwards in half that time.

Moreouer, let them bee moued with this condition, that whensoeuer the center of the great Epicycle B, commeth to the place of the Sunnes Apogæum, the center of the little Epicycle shal be in the Apogæum of the greater, and the Sunne in F next to B the great Epicycles center, and consequently BE and F (that is, the centers of both the Epicycles and of the Sunne) comming all together into the same right line of ♄ Suns Apogæum A G B F E H. Hereof it will follow that the diameter of the greater Epicycle shall alwaies be parallel to the line of the Sunnes Apogæum B A D, and whiles the center of the greater Epicycle from B to I, and the center of the lesser Epicycle from O to E moueth half a quadrant, the center of the Sunne from R to L shall moue an whole quadrant. Also the greater Epicycle hauing moued a whole quadrant from B to C, and the lesser likewise a whole quadrant from P to E, the Sun shall moue an whole semicircle from F to M. Therfore by this compound motion of the Homocentrick and both Epicycles, the Sunne shall seeme to describe as it were an eccentricall circle F L M N O, according to ♄ eccentricitie A S, which is but halfe so much as before, and yet the greatest Prosthaphæresis M A C, shall be the same almost as before, according to the Hypothesis of a simple eccentrick, whose eccentricitie were A T.

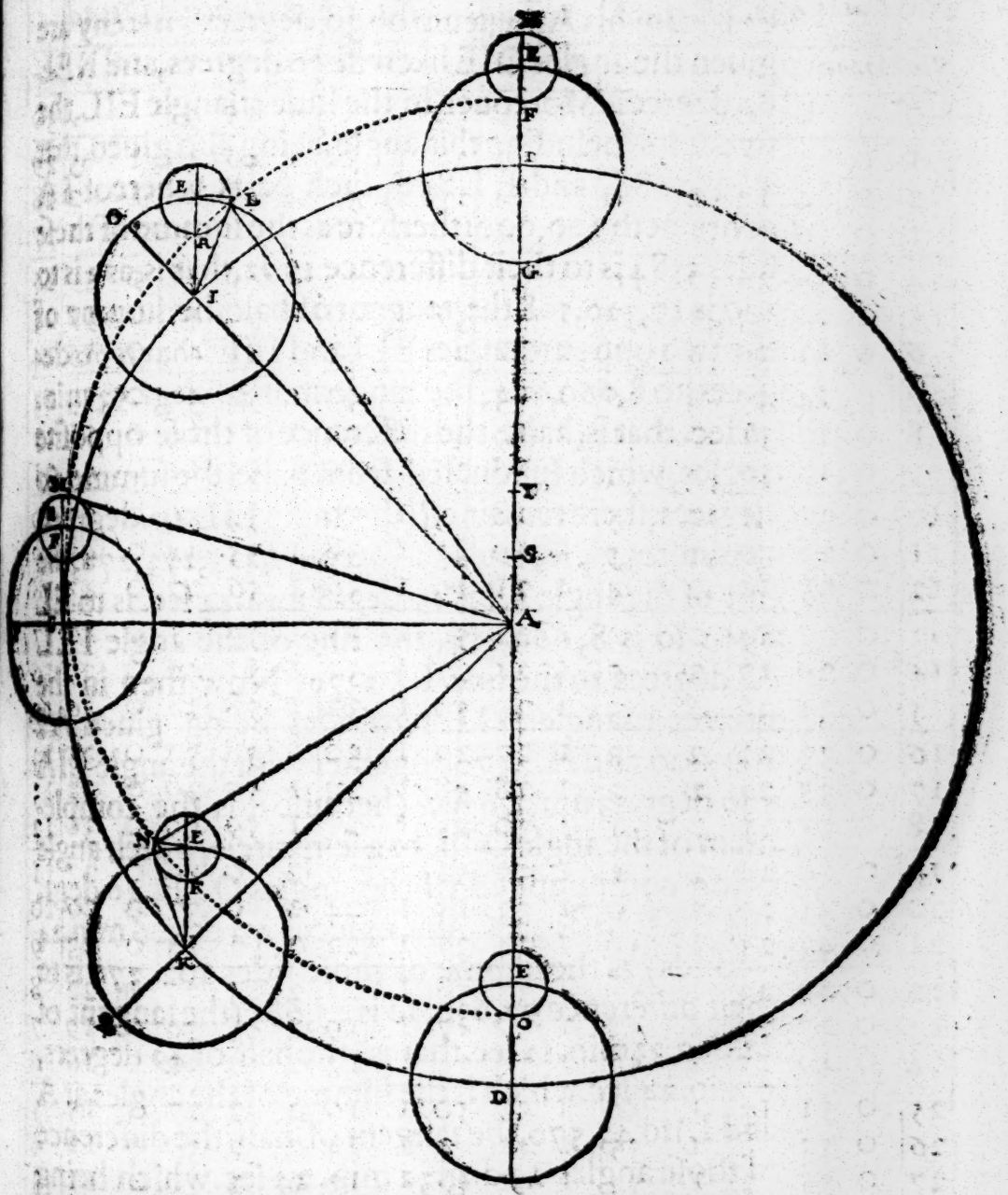
According to this Hypothesis was made the table of Prosthaphæreses here following, to euery degree of the Suns Anomalie, and that after this manner:

Admit

The making of the table of the Sunnes Prosthaphæreses.

Admit the angle B A I of the Sunnes middle motion from his Apogæum be 30 degrees: hereby are giuen the angles O I E likewise 30 degrees, and R E L 60 degrees. Moreouer, in the little triangle E I L, the two sides including this angle, being also giuen, that is I E 2688, and E L 896, such parts whereof I A conteineth 100,000: therfore as the summe of these sides 3584 is to their difference 1792, that is, as 2 is to 1, so is 17,320,508 the tangent of half the summe of the two opposite angles E L I and L I E (that is 60 degrees) to 8,660,254, the tangent of 40 degr. 53 min. 36 sec. that is, halfe the difference of those opposite angles, which subducted from halfe the summe 60 degrees, there remaineth the angle E I L 19. degrees, 6 minutes, 24 seconds. Moreouer, as 3,273,278, the sine of the angle L I E 19 deg. 6 min. 24 sec. is to E L 896: so is 8,660,254, the sine of the angle I E L 60 degrees to the side L I 2370. Now then in the greater triangle A I L two sides being giuen A I 100,000, and I L 2370, together with the angle L I A 130 degr. 53 min. 36 sec. (because it is the complement of the angle O I L to a semicircle, which angle being compounded of the angles O I E, 30 degr. and E I L 19 degr. 6 min. 24 sec. is 49 deg. 6 min. 24 seconds) as the summe of those sides 102,370 is to their difference 97,630, so is 45,685 (the tangent of 24 deg. 33 min. 12 sec. that is, the half of 49 degrees, 6 min. 24 sec. which is the summe of the angles at A and L) to 43,570, the tangent of half the difference of those angles 23 deg. 32 min. 24 sec. which being takē out of half the summe of them 24 deg. 33 min. 12 sec. there remaineth 1 degr. 0 min. 38 sec. the Suns Prosthaphæresis, when his motion of Anomalie or middle distance from his Apogæum is 30 degrees.

Thus



Thus we may finde the Sunnes Prosthaphæreses for euery degree of his Anomalie, and so make this table following.

	0 Subt.			Dif.ad.		1 Subtr.			Di.ad		2 Subtr.			Di.ad	
De.	Deg.	Mi.	Se.	Mi.	Sec.	Deg.	Mi.	Se.	Mi.	Se.	De.	Mi.	Se.	Mi.	Se.	De.
0		0	0			1	0	38			1	45	41			30
1	0	2	7	2	7	1	2	28	1	50	1	46	46	1	5	29
2	0	4	13	2	6	1	4	17	1	49	1	47	48	1	2	28
3	0	6	20	2	7	1	6	5	1	48	1	48	49	1	1	27
4	0	8	26	2	6	1	7	51	1	46	1	49	48	0	59	26
5	0	10	33	2	7	1	9	37	1	46	1	50	45	0	57	25
6	0	12	39	2	6	1	11	21	1	44	1	51	40	0	55	24
7	0	14	45	2	6	1	13	4	1	43	1	52	33	0	53	23
8	0	16	51	2	6	1	14	46	1	42	1	53	24	0	51	22
9	0	18	56	2	5	1	16	26	1	40	1	54	11	0	48	21
10	0	21	1	2	5	1	18	5	1	39	1	54	59	0	47	20
11	0	23	6	2	5	1	19	43	1	38	1	55	44	0	45	19
12	0	25	10	2	4	1	21	19	1	36	1	56	27	0	43	18
13	0	27	14	2	4	1	22	54	1	35	1	57	7	0	40	17
14	0	29	17	2	3	1	24	27	1	33	1	57	46	0	39	16
15	0	31	20	2	3	1	25	59	1	32	1	58	22	0	36	15
16	0	33	22	2	2	1	27	29	1	30	1	58	57	0	35	14
17	0	35	24	2	2	1	28	58	1	29	1	59	29	0	32	13
18	0	37	25	2	1	1	30	25	1	27	1	59	59	0	30	12
19	0	39	26	2	1	1	31	51	1	26	2	0	26	0	27	11
20	0	41	26	2	0	1	33	15	1	24	2	0	52	0	26	10
21	0	43	25	1	59	1	34	37	1	22	2	1	15	0	23	9
22	0	45	23	1	58	1	35	58	1	21	2	1	37	0	22	8
23	0	47	20	1	57	1	37	17	1	19	2	1	56	0	19	7
24	0	49	17	1	57	1	38	34	1	17	2	2	12	0	16	6
25	0	51	13	1	56	1	39	50	1	16	2	2	27	0	15	5
26	0	53	8	1	55	1	41	4	1	14	2	2	39	0	12	4
27	0	55	2	1	54	1	42	16	1	12	2	2	50	0	11	3
28	0	56	55	1	53	1	43	26	1	10	2	2	58	0	8	2
29	0	58	47	1	52	1	44	34	1	8	2	3	3	0	5	1
30	1	0	38	1	51	1	45	41	1	7	2	3	7	0	4	0
D.	11	Add.		Dif. S.		10	Add.		Dif S.		9	Add.		Dif.S.		D.

De	3 Subtr. Deg. Mi. Se	Dif. S. Mi. Sec.	4 Subtr. Deg. Mi. Se	Dif. S. Mi. Se.	5. Subtr. De. Mi. Se.	Dif. S. Mi. Se.	De
0	2 3 7		1 47 35		1 2 33		30
1	2 3 8	0 1	1 46 31	1 4	1 0 39	1 54	29
2	2 3 7	0 1	1 45 25	1 6	0 58 45	1 54	28
3	2 3 3	0 4	1 44 17	1 8	0 56 49	1 56	27
4	2 2 58	0 5	1 43 7	1 10	0 54 52	1 57	26
5	2 2 50	0 8	1 41 54	1 13	0 52 55	1 57	25
6	2 2 40	0 10	1 40 40	1 14	0 50 56	1 59	24
7	2 2 28	0 12	1 39 24	1 16	0 48 56	2 0	23
8	2 2 13	0 15	1 38 7	1 17	0 46 55	2 1	22
9	2 1 56	0 17	1 36 47	1 20	0 44 53	2 2	21
10	2 1 37	0 19	1 35 25	1 22	0 42 51	2 2	20
11	2 1 16	0 21	1 34 2	1 23	0 40 47	2 4	19
12	2 0 52	0 24	1 32 37	1 25	0 38 43	2 4	18
13	2 0 27	0 25	1 31 10	1 27	0 36 38	2 5	17
14	1 59 59	0 28	1 29 42	1 28	0 34 33	2 5	16
15	1 59 28	0 31	1 28 11	1 31	0 32 26	2 7	15
16	1 58 56	0 32	1 26 39	1 32	0 30 19	2 7	14
17	1 58 21	0 35	1 25 6	1 33	0 28 12	2 7	13
18	1 57 44	0 37	1 23 30	1 36	0 26 4	2 8	12
19	1 57 5	0 39	1 21 54	1 36	0 23 55	2 9	11
20	1 56 24	0 41	1 20 15	1 39	0 21 46	2 9	10
21	1 55 41	0 43	1 18 35	1 40	0 19 37	2 9	9
22	1 54 55	0 46	1 16 54	1 41	0 17 27	2 10	8
23	1 54 8	0 47	1 15 11	1 43	0 15 17	2 10	7
24	1 53 18	0 50	1 13 27	1 44	0 13 6	2 11	6
25	1 52 26	0 52	1 11 41	1 46	0 10 56	2 10	5
26	1 51 32	0 54	1 9 54	1 47	0 8 45	2 11	4
27	1 50 36	0 56	1 8 6	1 48	0 6 34	2 11	3
28	1 49 38	0 58	1 6 16	1 50	0 4 23	2 11	2
29	1 48 38	1 0	1 4 25	1 51	0 2 11	2 12	1
30	1 47 35	1 3	1 2 33	1 52	0 0 0	2 11	0
	8 Add.	Dif.ad.	7 Add.	Dif.ad	6. Add.	Dif.ad.	

Chap. XXIII.

The making of the Ephemerides of the Sunne hereafter following.

With helpe of the two former tables of the Suns middle motions and of his prosthaphæreses, the Suns true place may be readily found, and so the Ephemerides following easily made, after this manner: Reduce the apparent time giuen to the equall time answering thereto, with helpe of *Tycho Brahe* his table of æquation of naturall daies; and for that time so reduced adde together the Suns middle motions of longitude in yeeres, moneths, daies, houres, and minutes: out of the summe subtract the place of the Sunnes apogæum; the remainder shall be the Suns motion of Anomalie, or his distance from his apogæum.

Now if this Anomalie be lesse then a semicircle, looke the signe thereof in the head of the table of the Sunnes prosthaphæreses, and the degree in the first columne towards the left hand descending, and proceed in the same line towards the right hand, till you come vnder the foresaid signe of the Suns Anomalie, for there shall you haue the Sunnes prosthaphæresis for that time; remembring this withal, that if there be any minutes adhering to those degrees of Anomalie, that prosthaphæresis must be corrected by the part of the adiacent difference proportionall to those minutes, adding or subtracting the same hereto: according as you are directed in the head of the columne, wherein that difference is set down.

But

But if the Suns Anomalie be more then a ſemicircle, you muſt finde the ſignes thereof in the foote of the table, and the degrees in the laſt columne next the right hand aſcending, and in the common meeting of the line wherein you finde this degree, and of the columne of the ſaid ſigne of the Sunnes Anomalie, you ſhall finde the Sunnes Proſthaphæreſis, as before; which if there be any minutes adherent to the Sunnes Anomalie, muſt be corrected by the part proportionall of the difference adioyning, as before; adding or ſubtracting the ſame, according as you finde your direction in the foote of the columne conteining that difference.

As for example: Suppoſe you would know the Suns true place the 6 of May at noone (that is, the 5 of May complete according to Aſtronomicall account) in the yeere 1608, which time reduced to equalitie by the foreſaid table, ſhall be the 4 of May complete 23 houres, 48 minutes: for the Sun being at that time about the 26 degree of *Taurus*, that table ſheweth you that 12 minutes are to be ſubtracted from the apparent time to make it equall. For this time therefore let the middle motions of the Sunne be gathered together in this manner:

		Si.	*D.*	*M.*	*Se.*
The Suns middle motion of longitude for	the yere of Chriſt 1607 complete,	9	20	15	56
	Foure moneths of the leape yeare,	3	29	15	48
	Foure daies,		3	56	33
	23 houres,			56	40
	48 minutes.			1	58

	Si.	D.	M.	Se.
The ſumme of all theſe is the Suns middle motion of longitude for the time aforeſaid	1	24	26	55
The place of the Suns Apogæum for the yeare of Chriſt 1607 cõplete, is	3	5	45	0
The motion thereof in the moneths, daies, houres, &c. remaining, is				15
which put together, make the place of the Suns Apogæum for the time aforeſaid	3	5	45	15
This being ſubducted out of ỹ Suns middle motion,	1	24	26	55
there ſhall remaine the Suns motion of Anomalie	10	18	41	40
The Proſthaphæreſis anſwerable to 10 ſignes, 18 degr. you ſhall finde in the table of Proſthaphæreſes		1	21	19
with ỹ difference anſwering thereto			1	36
the part proportionall whereof anſwering to 41 min. 40 ſeconds, you ſhall finde to be			1	7
which ſubtracted out of the Proſthaphæreſis anſwering to 10 ſig. 18 de.		1	21	19
there remaineth the Proſthaphæreſis corrected		1	20	12
which being added to the Sunnes middle motion of longitude for the time aforeſaid	1	24	26	25
you ſhall haue the Sunnes true place for that time	1	25	47	7

agreeing iuſtly with the Ephemerides following, where you ſhall finde the Sunne at that time to be in 25 degr. 47 min. 7 ſec. of *Taurus*.

Admit

Admit alſo I would know the true place of the Sunne the 27 of October 1609 at noone, as we commonly account, (that is) for the 6 of October complete by the foreſaid account Aſtronomicall, which reduced to the equall time, will make 25 daies, 23 houres, 36 min. The Suns middle motions therefore, together with the reſt of the account, for finding the Sunnes true place for that time, may bee ſhortly gathered after this manner:

		Si.	*D.*	*M.*	*Se.*
The Suns middle motion of longitude for	the yere of Chriſt 1608 complete,	9	21	0	45
	September of the cõmon yere, cõplete	8	29	4	54
	Fiue & twenty daies		24	38	28
	Twenty three houres			56	40
	Thirty ſix minutes			1	29
The ſumme of theſe is the Sunnes middle motion of longitude for that time:		7	15	42	14
From whence ſubtract the place of the Sunnes Apogæum,		3	5	46	18
there remaineth ẏ Suns Anomalie		4	9	55	56
whereby is found the Suns Proſthaphæreſis			1	35	31
and by ſubtraction hereof, his true longitude,		7	14	6	45

agreeing likewiſe iuſtly with the Ephemerides following; after which manner alſo they may be wholly made. Notwithſtanding it is ſufficient to make ſome conuenient part of them in this manner, and (for ſparing time and labour) to ſupplie the reſt by

conuenient parts proportionall, whereof there may ſometimes ariſe ſome ſmall difference of a few ſeconds, which may worthily be neglected, ſeeing they can breed no ſenſible error in this buſineſſe.

Chap. XXIIII.

How to reduce the apparent time to the equall time anſwering thereto.

NOtwithſtanding the greateſt difference betweene the apparent and equall time be ſo ſmall, that by neglect thereof there can ſcarſe at any time ariſe thereof ſo much as one minute error in the place of the Sun; and conſequently not ſo much as half a minute error in his declination: yet becauſe the rules and grounds of Arts ought ſo much as may be to be free from all error, I haue therefore thought it better here to ſet downe the foreſaid table of æquation of naturall daies, rather then to leaue the Reader to ſeeke any further for ſo ſmall a matter, if any perhaps ſhall be deſirous to exerciſe himſelfe in calculating the Sunnes true place, according to the manner heere before ſet downe, either for the examining of the Suns Ephemerides here following, or any other; or for making ſome other like to theſe, when the date of them ſhall be expired; wherein, if perhaps you find ſome little difference of a few ſeconds from your calculation, you need not therewith to be any thing troubled, ſeeing it cannot produce any ſenſible error, neither in the Suns declination, nor yet in his place.

This

A Table of the æquation of naturall daies.

	♈	♉	♊	♋	♌	♍	♎	♏	♐	♑	♒	♓
	S	S	S	S	S	S	S	S	S	S	A	A
De	M.	Mi.	Mi.	M.	M.	Mi.	Mi.	Mi.	Mi.	Mi.	M.	M.
2	0	9	12	6	2	6	16½	24	21	7	5	7
4	1	9½	11	6	2	7	17	24	20	6	6	7
6	1	10	11	5½	2	7	18	24	19½	5	6	7
8	2	10	11	5	2	8	18	24½	19	4	6½	6½
10	3	11	11	5	2	9	19	24	18	3½	7	6
12	3	11	10	4	2	9	20	24	17	2½	7	6
14	4	11	10	4	3	10	20	24	16	2	7½	5
16	5	11	10	3½	3	11	21	24	15	1	8	5
18	5	11½	9	3	3	11½	21	24	14	0	8	4
20	6	12	9	3	3	12	22	23½	13½	A1	8	4
22	6	12	8½	3	4	13	22	23	12½	2	8	3
24	7	12	8	2½	4	13½	23	23	11½	3	8	2½
26	7½	12	8	2	5	14	23	22	10½	3	8	2
28	8	12	7	2	5	15	23	22	9½	4	8	1
30	8½	12	7	2	6	16	24	21	8½	5	7½	0½

This table must be thus vsed: With the signe and degree of the Suns true place take out in the common meeting the minutes of time; which according to the letters A,S, in the head of the table, must be added to or subtracted from the apparent time to make it equall: remembring to doe contrariwise if the equall time must bee changed into the apparent.

Chap. XXV.

A table of æquations of the Suns Ephemerides.

	Ianuary	*Febr.*	*March.*	*Aprill.*	*May.*	*Iune.*
Day.	*Mi. Se.*	*Mi. Se.*	*Mi. Se.*	*Mi. Se.*	*Mi. Se.*	*Min. Se.*
3	1 53	1 51	1 49	1 47	1 46	1 45
6	1 52	1 50	1 49	1 47	1 46	1 45
9	1 52	1 50	1 49	1 47	1 45	1 45
12	1 52	1 51	1 48	1 46	1 46	1 44
15	1 52	1 50	1 49	1 47	1 45	1 45
18	1 52	1 50	1 48	1 46	1 45	1 45
21	1 51	1 50	1 48	1 46	1 45	1 45
24	1 52	1 50	1 48	1 46	1 45	1 44
27	1 51	1 50	1 47	1 46	1 45	1 45
30	1 52		1 48	1 46	1 45	1 45

	Iuly.	*August*	*Sept.*	*Octob.*	*Nouem.*	*Decem.*
Day.	*Mi. Se.*	*Mi. Se.*	*Mi. Se.*	*Mi. Se.*	*Mi. Se.*	*Min. Se.*
3	1 45	1 45	1 48	1 49	1 51	1 52
6	1 45	1 46	1 48	1 50	1 52	1 52
9	1 45	1 46	1 48	1 50	1 52	1 52
12	1 45	1 46	1 48	1 50	1 52	1 53
15	1 45	1 47	1 49	1 50	1 52	1 52
18	1 45	1 47	1 48	1 51	1 52	1 52
21	1 45	1 47	1 49	1 50	1 52	1 52
24	1 46	1 47	1 49	1 51	1 52	1 53
27	1 46	1 47	1 49	1 51	1 52	1 52
30	1 45	1 47	1 49	1 52	1 53	1 52

By meanes of this table, and these Ephemerides, the true place of the Sun may most easily be found, for many yeares, either past, or to come; as shall hereafter be shewed in the next Chapter.

Leape yeare.	January.			February.			March.		
	♑			♒			♓		
Day.	Deg.	Mi.	Se.	Deg.	Mi.	Se.	Deg.	Mi.	Se.
1	20	47	21	22	17	51	21	23	9
2	21	48	38	23	18	28	22	22	49
3	22	49	52	24	19	3	23	22	27
4	23	51	6	25	19	37	24	22	2
5	24	52	18	26	20	8	25	21	36
6	25	53	30	27	20	39	26	21	7
7	26	54	40	28	21	7	27	20	37
8	27	55	49	29	21	34	28	20	4
9	28	56	57	♓	21	59	29	19	28
10	29	58	5	1	22	22	♈	18	51
11	♒	59	11	2	22	43	1	18	12
12	2	0	16	3	23	2	2	17	31
13	3	1	21	4	23	19	3	16	47
14	4	2	25	5	23	35	4	16	2
15	5	3	27	6	23	49	5	15	14
16	6	4	28	7	24	0	6	14	24
17	7	5	29	8	24	10	7	13	32
18	8	6	28	9	24	18	8	12	37
19	9	7	26	10	24	23	9	11	40
20	10	8	22	11	24	27	10	10	41
21	11	9	18	12	24	29	11	9	40
22	12	10	11	13	24	28	12	8	37
23	13	11	4	14	24	25	13	7	32
24	14	11	55	15	24	21	14	6	25
25	15	12	45	16	24	14	15	5	15
26	16	13	33	17	24	5	16	4	4
27	17	14	20	18	23	54	17	2	50
28	18	15	5	19	23	41	18	1	34
29	19	15	49	20	23	26	19	0	15
30	20	16	31				19	58	54
31	21	17	12				20	57	32

Leape yeare.	*April.* ♈			*May.* ♉			*Iune.* ♊		
Day.	*Deg.*	*Mi.*	*Se.*	*Deg.*	*Mi.*	*Se.*	*Deg.*	*Mi.*	*Se.*
1	21	56	7	20	59	3	20	37	23
2	22	54	41	21	56	43	21	34	31
3	23	53	13	22	54	21	22	31	38
4	24	51	42	23	51	58	23	28	46
5	25	50	10	24	49	33	24	25	52
6	26	48	35	25	47	7	25	22	58
7	27	46	58	26	44	40	26	20	4
8	28	45	19	27	42	11	27	17	10
9	29	43	37	28	39	41	28	14	15
10	♉	41	55	29	37	9	29	11	20
11	1	40	10	♊	34	36	♋	8	24
12	2	38	24	1	32	2	1	5	29
13	3	36	35	2	29	27	2	2	33
14	4	34	45	3	26	51	2	59	37
15	5	32	53	4	24	14	3	56	41
16	6	30	59	5	21	36	4	53	45
17	7	29	4	6	18	56	5	50	49
18	8	27	6	7	16	16	6	47	53
19	9	25	6	8	13	35	7	44	57
20	10	23	5	9	10	53	8	42	1
21	11	21	3	10	8	10	9	39	5
22	12	18	58	11	5	26	10	36	9
23	13	16	52	12	2	41	11	33	14
24	14	14	44	12	59	55	12	30	19
25	15	12	34	13	57	9	13	27	24
26	16	10	23	14	54	22	14	24	29
27	17	8	10	15	51	33	15	21	24
28	18	5	56	16	48	45	16	18	40
29	19	3	40	17	45	55	17	15	47
30	20	1	22	18	43	5	18	12	53
31				19	40	14			

Leape yeare.	*July.* ♋			*August.* ♌			*September.* ♍		
Day.	*Deg.*	*Mi.*	*Se.*	*Deg.*	*Mi.*	*Se.*	*Deg.*	*Mi.*	*Se.*
1	19	10	0	18	47	12	18	46	59
2	20	7	7	19	44	50	19	45	33
3	21	4	15	20	42	30	20	44	8
4	22	1	24	21	40	10	21	42	46
5	22	58	33	22	37	53	22	41	26
6	23	55	43	23	35	37	23	40	7
7	24	52	53	24	33	23	24	38	51
8	25	50	4	25	31	10	25	37	37
9	26	47	16	26	28	59	26	36	26
10	27	44	28	27	26	49	27	35	17
11	28	41	41	28	24	41	28	34	10
12	29	38	55	29	22	35	29	33	5
13	♌	36	10	♍	20	31	♎	32	2
14	1	33	26	1	18	28	1	31	1
15	2	30	42	2	16	27	2	30	2
16	3	28	0	3	14	28	3	29	6
17	4	25	19	4	12	31	4	28	12
18	5	22	38	5	10	35	5	27	20
19	6	19	59	6	8	42	6	26	30
20	7	17	20	7	6	50	7	25	43
21	8	14	43	8	5	0	8	24	58
22	9	12	6	9	3	12	9	24	15
23	10	9	31	10	1	26	10	23	34
24	11	6	57	10	59	42	11	22	55
25	12	4	25	11	57	59	12	22	18
26	13	1	53	12	56	18	13	21	43
27	13	59	23	13	54	40	14	21	11
28	14	56	54	14	53	0	15	20	41
29	15	54	27	15	51	29	16	20	13
30	16	52	1	16	49	57	17	19	48
31	17	49	36	17	48	27			

Leape yeare.	*Aprill.*	*May.*	*Iune.*
	♈	♉	♊
Day.	*Deg. Mi. Se.*	*Deg. Mi. Se.*	*Deg. Mi. Se.*
29	19 3 40	17 45 55	17 15 47
30	20 1 22	18 43 5	18 12 53
31		19 40 14	

IRREGU
PAGINAT

Leape yeare. Day.	July. ♋ Deg. Mi. Se.	August. ♌ Deg. Mi. Se.	September. ♍ Deg. Mi. Se.
29	15 54 27	15 51 29	16 20 13
30	16 52 1	16 49 57	17 19 48
31	17 49 36	17 48 27	

9 38 16 6 7 1 17 6 7 0 5 21 12 6 20 0 0 38 5 4 5 8 31 1

Leape yeare.	Aprill. ♈			May. ♉			Iune. ♊		
Day.	Deg.	Mi.	Se.	Deg.	Mi.	Se.	Deg.	Mi.	Se.
1	21	56	7	20	59	3	20	37	23
2	22	54	41	21	56	43	21	34	31
3	23	53	13	22	54	21	22	31	38
4	24	51	42	23	51	58	23	28	46
5	25	50	10	24	49	33	24	25	52
6	26	48	35	25	47	7	25	22	58
7	27	46	58	26	44	40	26	20	4
8	28	45	19	27	42	11	27	17	10
9	29	43	37	28	39	41	28	14	15
10	♉	41	55	29	37	9	29	11	20
11	1	40	10	♊	34	36	♋	8	24
12	2	38	24	1	32	2	1	5	29
13	3	36	35	2	29	27	2	2	33
14	4	34	45	3	26	51	2	59	37
15	5	32	53	4	24	14	3	56	41
16	6	30	59	5	21	36	4	53	45
17	7	29	4	6	18	56	5	50	49
18	8	27	6	7	16	16	6	47	53
19	9	25	6	8	13	35	7	44	57
20	10	23	5	9	10	53	8	42	1
21	11	21	3	10	8	10	9	39	5
22	12	18	58	11	5	26	10	36	9
23	13	16	52	12	2	41	11	33	14
24	14	14	44	12	59	55	12	30	19
25	15	12	34	13	57	9	13	27	24
26	16	10	23	14	54	22	14	24	29
27	17	8	10	15	51	33	15	21	24
28	18	5	56	16	48	45	16	18	40
29	19	3	40	17	45	55	17	15	47
30	20	1	22	18	43	5	18	12	53
31				19	40	14			

Leape yeare.	July. ♋			August. ♌			September. ♍		
Day.	Deg.	Mi.	Se.	Deg.	Mi.	Se.	Deg.	Mi.	Se.
1	19	10	0	18	47	12	18	46	59
2	20	7	7	19	44	50	19	45	33
3	21	4	15	20	42	30	20	44	8
4	22	1	24	21	40	10	21	42	46
5	22	58	33	22	37	53	22	41	26
6	23	55	43	23	35	37	23	40	7
7	24	52	53	24	33	23	24	38	51
8	25	50	4	25	31	10	25	37	37
9	26	47	16	26	28	59	26	36	26
10	27	44	28	27	26	49	27	35	17
11	28	41	41	28	24	41	28	34	10
12	29	38	55	29	22	35	29	33	5
13	♌	36	10	♍	20	31	♎	32	2
14	1	33	26	1	18	28	1	31	1
15	2	30	42	2	16	27	2	30	2
16	3	28	0	3	14	28	3	29	6
17	4	25	19	4	12	31	4	28	12
18	5	22	38	5	10	35	5	27	20
19	6	19	59	6	8	42	6	26	30
20	7	17	20	7	6	50	7	25	43
21	8	14	43	8	5	0	8	24	58
22	9	12	6	9	3	12	9	24	15
23	10	9	31	10	1	26	10	23	34
24	11	6	57	10	59	42	11	22	55
25	12	4	25	11	57	59	12	22	18
26	13	1	53	12	56	18	13	21	43
27	13	59	23	13	54	40	14	21	11
28	14	56	54	14	53	0	15	20	41
29	15	54	27	15	51	29	16	20	13
30	16	52	1	16	49	57	17	19	48
31	17	49	36	17	48	27			

Leape yeare.	*October.* ♎			*November.* ♏			*December.* ♐		
Day.	*Deg.*	*Mi.*	*Se*	*Deg.*	*Mi.*	*Se*	*Deg.*	*Mi.*	*Se.*
1	18	19	25	19	24	15	19	53	44
2	19	19	3	20	24	55	20	54	58
3	20	18	44	21	25	36	21	56	13
4	21	18	26	22	26	19	22	57	29
5	22	18	11	23	27	3	23	58	45
6	23	17	58	24	27	49	25	0	2
7	24	17	47	25	28	37	26	1	19
8	25	17	38	26	29	25	27	2	37
9	26	17	32	27	30	15	28	3	55
10	27	17	28	28	31	7	29	5	13
11	28	17	26	29	32	0	♑	6	32
12	29	17	27	♐	32	55	1	7	50
13	♏	17	29	1	33	51	2	9	9
14	1	17	33	2	34	49	3	10	29
15	2	17	39	3	35	47	4	11	48
16	3	17	47	4	36	47	5	13	7
17	4	17	57	5	37	48	6	14	26
18	5	18	9	6	38	50	7	15	45
19	6	18	23	7	39	53	8	17	3
20	7	18	40	8	40	58	9	18	22
21	8	18	58	9	42	3	10	19	40
22	9	19	18	10	43	9	11	20	58
23	10	19	39	11	44	17	12	22	16
24	11	20	3	12	45	25	13	23	34
25	12	20	29	13	46	34	14	24	52
26	13	20	56	14	47	44	15	26	9
27	14	21	25	15	48	55	16	27	26
28	15	21	55	16	50	6	17	28	43
29	16	22	28	17	51	18	18	29	59
30	17	23	1	18	52	30	19	31	15
31	18	23	38				20	32	30

First yeare.	Iannary. ♑			February. ♒			March. ♓		
Day.	Deg.	Mi.	Se.	Deg.	Mi.	Se.	Deg.	Mi.	Se.
1	21	33	47	23	3	46	21	8	40
2	22	35	2	24	4	22	22	8	21
3	23	36	16	25	4	56	23	8	0
4	24	37	29	26	5	28	24	7	36
5	25	38	40	27	5	59	25	7	10
6	26	39	51	28	6	28	26	6	42
7	27	41	0	29	6	55	27	6	12
8	28	42	9	♓	7	20	28	5	39
9	29	43	16	1	7	43	29	5	4
10	♒	44	22	2	8	5	♈	4	28
11	1	45	28	3	8	25	1	3	49
12	2	46	33	4	8	43	1	3	8
13	3	47	37	5	8	59	3	2	25
14	4	48	39	6	9	13	4	1	41
15	5	49	41	7	9	25	5	0	53
16	6	50	42	8	9	35	6	0	4
17	7	51	41	9	9	43	6	59	12
18	8	52	39	10	9	50	7	58	18
19	9	53	36	11	9	54	8	57	21
20	10	54	32	12	9	56	9	56	23
21	11	55	26	13	9	56	10	55	22
22	12	56	19	14	9	54	11	54	20
23	13	57	10	15	9	49	12	53	15
24	14	58	0	16	9	43	13	52	8
25	15	58	49	17	9	35	14	51	0
26	16	59	36	18	9	24	15	49	49
27	18	0	22	19	9	12	16	48	35
28	19	1	6	20	8	57	17	47	20
29	10	1	49				18	46	0
30	21	2	30				19	44	41
31	22	3	9				20	43	19

First yeare.	April. ♈			May. ♉			June. ♊		
Day.	Deg.	Mi.	Se.	Deg.	Mi.	Se.	Deg.	Mi.	Se.
1	21	41	55	20	45	5	20	23	32
2	22	40	29	21	42	44	21	20	40
3	23	39	2	22	40	23	22	17	48
4	24	37	32	23	38	0	23	14	55
5	25	36	0	24	35	36	24	12	2
6	26	34	25	25	33	10	25	9	8
7	27	32	49	26	30	43	26	6	14
8	28	31	10	27	28	14	27	3	19
9	29	29	29	28	25	44	28	0	25
10	♉	27	47	29	23	13	28	57	30
11	1	26	3	♊	20	41	29	54	34
12	2	24	17	1	18	7	♋	51	39
13	3	22	29	2	15	32	1	48	43
14	4	20	40	3	12	56	2	45	47
15	5	18	48	4	10	19	3	42	51
16	6	16	55	5	7	41	4	39	55
17	7	14	59	6	5	3	5	36	59
18	8	13	2	7	2	23	6	34	3
19	9	11	3	7	59	42	7	31	7
20	10	9	2	8	57	0	8	28	11
21	11	7	0	9	54	17	9	25	15
22	12	4	56	10	51	33	10	22	20
23	13	2	50	11	48	49	11	19	24
24	14	0	42	12	46	3	12	16	29
25	14	58	33	13	43	17	13	13	34
26	15	56	22	14	40	30	14	10	39
27	16	54	10	15	37	42	15	7	34
28	17	51	56	16	34	53	16	4	50
29	18	49	40	17	32	4	17	1	56
30	19	47	23	18	29	14	17	59	3
31				19	26	23			

First yeare.	July. ♋			August. ♌			September. ♍		
Day.	Deg.	Mi.	Se.	Deg.	Mi.	Se.	Deg.	Mi.	Se.
1	18	56	9	18	33	14	18	32	48
2	19	53	17	19	30	52	19	31	21
3	20	50	24	20	28	31	20	29	56
4	21	47	33	21	26	12	21	28	33
5	22	44	42	22	23	54	22	27	12
6	23	41	51	23	21	37	23	25	54
7	24	39	2	24	19	23	24	24	38
8	25	36	13	25	17	10	25	23	23
9	26	33	24	26	14	58	26	22	11
10	27	30	36	27	12	48	27	21	1
11	28	27	49	28	10	40	28	19	53
12	29	25	3	29	8	33	29	18	48
13	♌	22	18	♍	6	28	♎	17	45
14	1	19	33	1	4	25	1	16	43
15	2	16	49	2	2	24	2	15	44
16	3	14	7	3	0	24	3	14	47
17	4	11	25	3	58	27	4	13	52
18	5	8	44	4	56	31	5	13	0
19	6	6	5	5	54	37	6	12	10
20	7	3	26	6	52	45	7	11	22
21	8	0	49	7	50	55	8	10	36
22	8	58	12	8	49	6	9	9	53
23	9	55	36	9	47	20	10	9	11
24	10	53	2	10	45	35	11	8	32
25	11	50	29	11	43	52	12	7	54
26	12	47	58	12	42	10	13	7	19
27	13	45	27	13	40	31	14	6	46
28	14	42	58	14	38	54	15	6	16
29	15	40	30	15	37	19	16	5	47
30	16	38	4	16	35	47	17	5	22
31	17	35	38	17	34	16			

First yeare.	October. ♎			November. ♏			December. ♐		
Day.	Deg.	Mi.	Se	Deg.	Mi.	Se	Deg.	Mi.	Se.
1	18	4	58	19	9	34	19	38	53
2	19	4	36	20	10	13	20	40	7
3	20	4	16	21	10	54	21	41	22
4	21	3	58	22	11	36	22	42	38
5	22	3	42	23	12	20	23	43	54
6	23	3	29	24	13	6	24	45	11
7	24	3	17	25	13	53	25	46	28
8	25	3	8	26	14	41	26	47	45
9	26	3	1	27	15	31	27	49	3
10	27	2	57	28	16	22	28	50	22
11	28	2	54	29	17	15	23	51	40
12	29	2	54	♐	18	9	♑	52	59
13	♏	2	56	1	19	5	1	54	18
14	1	2	59	2	20	2	2	55	37
15	2	3	5	3	21	1	3	56	56
16	3	3	13	4	22	0	4	58	15
17	4	3	22	5	23	1	5	59	34
18	5	3	34	6	24	3	7	0	53
19	6	3	48	7	25	6	8	2	11
20	7	4	3	8	26	10	9	3	30
21	8	4	21	9	27	15	10	4	49
22	9	4	40	10	28	21	11	6	7
23	10	5	2	11	29	28	12	7	25
24	11	5	25	12	30	36	13	8	43
25	12	5	50	13	31	45	14	10	1
26	13	6	17	14	32	55	15	11	18
27	14	6	45	15	34	5	16	12	35
28	15	7	15	16	35	16	17	13	52
29	16	7	47	17	36	28	18	15	8
30	17	8	21	18	37	40	19	16	24
31	18	8	57				20	17	39

Secõd yeare.	Ianuary. ♑			Februarie. ♒			March. ♓		
Day.	Deg.	Mi.	Se.	Deg.	Mi.	Se.	Deg.	Mi.	Se.
1	21	18	56	22	49	5	20	54	12
2	22	20	11	23	49	41	21	53	53
3	23	21	25	24	50	15	22	53	32
4	24	22	38	25	50	48	23	53	9
5	25	23	50	26	51	19	24	52	44
6	26	25	1	27	51	48	25	52	16
7	27	26	51	28	52	16	26	51	46
8	28	27	19	29	52	41	27	51	15
9	29	28	27	♓	53	5	28	50	40
10	♒	29	34	1	53	27	29	50	4
11	1	30	40	2	53	48	♈	49	26
12	2	31	45	3	54	6	1	48	46
13	3	32	49	4	54	22	2	48	3
14	4	33	52	5	54	37	3	47	19
15	5	34	54	6	54	50	4	46	32
16	6	35	54	7	55	0	5	45	44
17	7	36	54	8	55	9	6	44	52
18	8	37	53	9	55	16	7	43	59
19	9	38	50	10	55	20	8	43	3
20	10	39	46	11	55	23	9	42	5
21	11	40	40	12	55	23	10	41	5
22	12	41	34	13	55	22	11	40	2
23	13	42	25	14	55	18	12	38	58
24	14	43	16	15	55	12	13	37	52
25	15	44	5	16	55	4	14	36	44
26	16	44	52	17	54	54	15	35	33
27	17	45	38	18	54	43	16	34	20
28	18	46	23	19	54	28	17	33	5
29	19	47	6				18	31	48
30	20	47	47				19	30	28
31	21	48	27				20	29	7

Secõd yeare.	April.			May.			June.		
	♈			♉			♊		
Day.	Deg.	Mi.	Se.	Deg.	Mi.	Se.	Deg.	Mi.	Se.
1	21	27	43	20	31	6	20	9	41
2	22	26	18	21	28	46	21	6	49
3	23	24	50	22	26	25	22	3	57
4	24	23	21	23	24	2	23	1	4
5	25	21	50	24	21	38	23	58	11
6	26	20	16	25	19	13	24	55	18
7	27	18	40	26	16	46	25	52	24
8	28	17	2	27	14	18	26	49	29
9	29	15	21	28	11	48	27	46	35
10	♉	13	39	29	9	17	28	43	40
11	1	11	56	♊	6	45	29	40	44
12	2	10	10	1	4	12	♋	37	49
13	3	8	23	2	1	37	1	34	53
14	4	6	34	2	59	2	2	31	57
15	5	4	43	3	56	25	3	29	2
16	6	2	50	4	53	47	4	26	6
17	7	0	55	5	51	9	5	23	9
18	7	58	58	6	48	29	6	20	13
19	8	56	59	7	45	48	7	17	17
20	9	54	59	8	42	7	8	14	21
21	10	52	57	9	40	24	9	11	25
22	11	50	53	10	37	41	10	8	30
23	12	48	48	11	34	56	11	5	34
24	13	46	41	12	32	11	12	2	39
25	14	44	32	13	29	25	12	59	43
26	15	42	22	14	26	38	13	56	49
27	16	40	10	15	23	50	14	53	44
28	17	37	56	16	21	1	15	51	0
29	18	35	41	17	18	12	16	48	6
30	19	33	24	18	15	22	17	45	12
31				19	12	32			

Secõd yeare.	July. ♋			August. ♌			September. ♍		
Day.	Deg.	Mi.	Se.	Deg.	Mi.	Se.	Deg.	Mi.	Se.
1	18	42	19	18	19	17	18	18	37
2	19	39	26	19	16	54	19	17	10
3	20	36	34	20	14	33	20	15	44
4	21	33	42	21	12	13	21	14	21
5	22	30	51	22	9	55	22	12	59
6	23	28	0	23	7	38	23	11	40
7	24	25	10	24	5	23	24	10	23
8	25	22	21	25	3	9	25	9	8
9	26	19	32	26	0	57	26	7	56
10	27	16	45	26	58	47	27	6	45
11	28	13	57	27	56	38	28	5	37
12	29	11	11	28	54	31	29	4	31
13	♌	8	25	29	52	26	♎	3	27
14	1	5	40	♍	50	23	1	2	25
15	2	2	57	1	48	21	2	1	26
16	3	0	14	2	46	21	3	0	28
17	3	57	32	3	44	23	3	59	33
18	4	54	51	4	42	26	4	58	40
19	5	52	11	5	40	32	5	57	49
20	6	49	32	6	38	39	6	57	1
21	7	46	54	7	36	49	7	56	15
22	8	44	17	8	35	0	8	55	31
23	9	41	42	9	33	13	9	54	49
24	10	39	7	10	31	27	10	54	9
25	11	36	34	11	29	44	11	53	31
26	12	34	2	12	28	0	12	52	55
27	13	31	31	13	26	22	13	52	21
28	14	29	2	14	24	45	14	51	50
29	15	26	33	15	23	10	15	51	22
30	16	24	7	16	21	36	16	50	55
31	17	21	41	17	20	5			

Secõd yeare.	October. ♎			November. ♏			December. ♐		
Day.	Deg.	Mi.	Se.	Deg.	Mi.	Se.	Deg.	Mi.	Se.
1	17	50	31	18	54	52	19	24	3
2	18	50	9	19	55	31	20	25	17
3	19	49	48	20	56	11	21	26	32
4	20	49	30	21	56	53	22	27	47
5	21	49	13	22	57	37	23	29	3
6	22	48	59	23	58	22	24	30	20
7	23	48	47	24	59	3	25	31	37
8	24	48	37	25	59	57	26	32	54
9	25	48	30	27	0	46	27	34	12
10	26	48	25	28	1	37	28	35	30
11	27	48	22	29	2	30	29	36	49
12	28	48	22	♐	3	23	♑	38	7
13	29	48	23	1	4	19	1	39	26
14	♏	48	26	2	5	16	2	40	45
15	1	48	31	3	6	14	3	42	4
16	2	48	38	4	7	13	4	43	24
17	3	48	47	5	8	14	5	44	43
18	4	48	58	6	9	15	6	46	1
19	5	49	12	7	10	18	7	47	20
20	6	49	27	8	11	22	8	48	39
21	7	49	44	9	12	26	9	49	57
22	8	50	3	10	13	32	10	51	16
23	9	50	24	11	14	39	11	52	34
24	10	50	47	12	15	47	12	53	52
25	11	51	11	13	16	56	13	55	9
26	12	51	38	14	18	5	14	56	27
27	13	52	6	15	19	15	15	57	44
28	14	52	36	16	20	26	16	59	1
29	15	53	7	17	21	38	18	0	17
30	16	53	40	18	22	50	19	1	33
31	17	54	15				20	2	48

Third yeare.	January. ♑			February. ♒			March. ♓		
Day.	Deg.	Mi.	Se.	Deg.	Mi.	Se.	Deg.	Mi.	Se.
1	21	4	5	22	34	23	20	39	44
2	22	5	21	23	35	0	21	39	26
3	23	6	35	24	35	35	22	39	5
4	24	7	48	25	36	8	23	38	43
5	25	9	0	26	36	39	24	38	18
6	26	10	11	27	37	9	25	37	51
7	27	11	21	28	37	37	26	37	21
8	28	12	30	29	38	3	27	36	50
9	29	13	38	♓	38	27	28	36	17
10	♒	14	45	1	38	50	29	35	41
11	1	15	51	2	39	10	♈	35	3
12	2	16	56	3	39	29	1	34	23
13	3	18	1	4	39	46	2	33	41
14	4	19	4	5	40	1	3	32	58
15	5	20	6	6	40	14	4	32	12
16	6	21	7	7	40	25	5	31	23
17	7	22	7	8	40	35	6	30	33
18	8	23	6	9	40	42	7	29	40
19	9	24	4	10	40	47	8	28	44
20	10	25	0	11	40	50	9	27	47
21	11	25	55	12	40	51	10	26	47
22	12	26	48	13	40	50	11	25	45
23	13	27	40	14	40	47	12	24	42
24	14	28	31	15	40	41	13	23	36
25	15	29	21	16	40	34	14	22	28
26	16	30	8	17	40	25	15	21	18
27	17	30	55	18	40	13	16	20	6
28	18	31	40	19	40	0	17	18	51
29	19	32	23				18	17	35
30	20	33	5				19	16	15
31	21	33	45				20	14	54

Third yeare.	*Aprill.* ♈			*May.* ♉			*Iune.* ♊		
Day.	*Deg.*	*Mi.*	*Se.*	*Deg.*	*Mi.*	*Se.*	*Deg.*	*Mi.*	*Se.*
1	21	13	31	20	17	7	19	55	50
2	22	12	6	21	14	48	20	52	58
3	23	10	39	22	12	27	21	50	6
4	24	9	10	23	10	4	22	47	14
5	25	7	39	24	7	41	23	44	21
6	26	6	6	25	5	16	24	41	27
7	27	4	31	26	2	49	25	38	33
8	28	2	53	27	0	21	26	35	39
9	29	1	13	27	57	52	27	32	44
10	29	53	32	28	55	22	28	29	50
11	♉	57	49	29	52	50	29	26	54
12	1	56	4	♊	50	17	♋	24	0
13	2	54	17	1	47	43	1	21	3
14	3	52	28	2	45	7	2	18	8
15	4	50	37	3	42	31	3	15	12
16	5	48	45	4	39	53	4	12	16
17	6	46	50	5	37	15	5	9	20
18	7	44	54	6	34	35	6	6	24
19	8	42	56	7	31	55	7	3	28
20	9	40	56	8	28	14	8	0	32
21	10	38	54	9	26	31	8	57	36
22	11	36	51	10	23	48	9	54	40
23	12	34	46	11	21	4	10	51	44
24	13	32	39	12	18	18	11	48	49
25	14	30	31	13	15	33	12	45	53
26	15	28	21	14	12	46	13	42	58
27	16	26	9	15	9	58	14	39	54
28	17	23	56	16	7	10	15	37	9
29	18	21	41	17	4	21	16	34	15
30	19	19	25	18	1	31	17	31	22
31				18	58	41			

Third yeare.	July. ♋			August. ♌			September. ♍		
Day.	Deg.	Mi.	Se.	Deg.	Mi.	Se	Deg.	Mi.	Se.
1	18	28	28	18	5	19	18	4	25
2	19	25	35	19	2	56	19	2	58
3	20	22	43	20	0	34	20	1	32
4	21	19	51	20	58	14	21	0	8
5	22	17	0	21	55	55	21	58	46
6	23	14	9	22	53	38	22	57	26
7	24	11	19	23	51	23	23	56	9
8	25	8	29	24	49	9	24	54	53
9	26	5	41	25	46	56	25	53	40
10	27	2	53	26	44	46	26	52	30
11	28	0	5	27	42	37	27	51	20
12	28	57	19	28	40	29	28	50	14
13	29	54	33	29	38	24	29	49	10
14	♌	51	48	♍	36	20	♎	48	8
15	1	49	4	1	34	18	1	47	7
16	2	46	21	2	32	17	2	46	9
17	3	43	39	3	30	19	3	45	13
18	4	40	57	4	28	22	4	44	20
19	5	38	17	5	26	27	5	43	29
20	6	35	38	6	24	34	6	42	40
21	7	33	0	7	22	43	7	41	53
22	8	30	23	8	20	53	8	41	9
23	9	27	47	9	19	6	9	40	26
24	10	25	12	10	17	20	10	39	46
25	11	22	38	11	15	36	11	39	7
26	12	20	6	12	13	54	12	38	31
27	13	17	35	13	12	14	13	37	57
28	14	15	5	14	10	36	14	37	25
29	15	12	37	15	9	0	15	36	56
30	16	10	9	16	7	26	16	36	29
31	17	7	44	17	5	55			

Third yeare.	*October.* ♎			*November.* ♏			*December.* ♐		
Day.	*Deg.*	*Mi.*	*Se.*	*Deg.*	*Mi.*	*Se.*	*Deg.*	*Mi.*	*Se.*
1	17	36	4	18	40	11	19	9	13
2	18	35	41	19	40	49	20	10	26
3	19	35	21	20	41	29	21	11	41
4	20	35	2	21	42	10	22	12	56
5	21	34	45	22	42	54	23	14	12
6	22	34	30	23	43	38	24	15	29
7	23	34	17	24	44	19	25	16	45
8	24	34	7	25	45	12	26	18	3
9	25	33	59	26	46	2	27	19	20
10	26	33	54	27	46	52	28	20	39
11	27	33	50	28	47	44	29	21	57
12	28	33	49	29	48	38	♑	23	16
13	29	33	50	♐	49	33	1	24	34
14	♏	33	52	1	50	29	2	25	54
15	1	33	57	2	51	27	3	27	13
16	2	34	4	3	52	26	4	28	32
17	3	34	12	4	53	26	5	29	51
18	4	34	23	5	54	28	6	31	10
19	5	34	36	6	55	30	7	32	29
20	6	34	50	7	56	33	8	33	47
21	7	35	7	8	57	38	9	35	6
22	8	35	26	9	58	44	10	36	24
23	9	35	46	10	59	50	11	37	42
24	10	36	8	12	0	58	12	39	0
25	11	36	32	13	2	6	13	40	18
26	12	36	58	14	3	16	14	41	35
27	13	37	26	15	4	26	15	42	53
28	14	37	56	16	5	36	16	44	9
29	15	38	27	17	6	48	17	45	26
30	16	38	59	18	8	0	18	46	42
31	17	39	34				19	47	58

Fourth yeare.	*January.* ♑			*February.* ♒			*March.* ♓		
Day.	*Deg.*	*Mi.*	*Se.*	*Deg.*	*Mi.*	*Se.*	*Deg.*	*Mi.*	*Se.*
1	20	49	14	22	19	42	21	24	58
2	21	50	30	23	20	19	22	24	38
3	22	51	45	24	20	54	23	24	16
4	23	52	58	25	21	28	24	23	52
5	24	54	11	26	21	59	25	23	25
6	25	55	22	27	22	29	26	22	56
7	26	56	32	28	22	58	27	22	26
8	27	57	41	29	23	24	28	21	53
9	28	58	49	♓	23	49	29	21	17
10	29	59	57	1	24	12	♈	20	40
11	1	♒ 1	3	2	24	33	1	20	1
12	2	2	8	3	24	53	2	19	19
13	3	3	13	4	25	10	3	18	36
14	4	4	16	5	25	25	4	17	51
15	5	5	19	6	25	39	5	17	3
16	6	6	20	7	25	51	6	16	13
17	7	7	20	8	26	0	7	15	20
18	8	8	20	9	26	8	8	14	25
19	9	9	17	10	26	14	9	13	28
20	10	10	14	11	26	17	10	12	29
21	11	11	9	12	26	19	11	11	28
22	12	12	3	13	28	18	12	10	25
23	13	12	56	14	26	15	13	9	20
24	14	13	47	15	26	11	14	8	13
25	15	14	36	16	26	4	15	7	3
26	16	15	24	17	25	55	16	5	51
27	17	16	11	18	25	44	17	4	37
28	18	16	57	19	25	31	18	3	21
29	19	17	41	20	25	16	19	2	2
30	20	18	23				20	0	42
31	21	19	3				20	59	19

Fourth yeare.	April.			May.			June.		
	♈			♉			♊		
Day.	Deg.	Mi.	Se.	Deg.	Mi.	Se.	Deg.	Mi.	Se.
1	21	57	55	21	0	49	20	39	8
2	22	56	28	21	58	29	21	36	16
3	23	55	0	22	56	7	22	33	23
4	24	53	29	23	53	43	23	30	30
5	25	51	57	24	51	19	24	27	37
6	26	50	22	25	48	53	25	24	23
7	27	48	45	26	46	25	26	21	49
8	28	47	5	27	43	56	27	18	54
9	29	45	24	28	41	26	28	16	0
10	♉	43	41	29	38	54	29	13	4
11	1	41	57	♊	36	22	♋	10	10
12	2	40	10	1	33	48	1	7	13
13	3	38	22	2	31	12	2	4	18
14	4	36	32	3	28	36	3	1	22
15	5	34	40	4	25	59	3	58	26
16	6	32	46	5	23	21	4	55	30
17	7	30	50	6	20	42	5	52	34
18	8	28	52	7	18	1	6	49	38
19	9	26	53	8	14	20	7	46	42
20	10	24	52	9	12	38	8	43	46
21	11	22	49	10	9	55	9	40	50
22	12	20	44	11	7	11	10	37	54
23	13	18	38	12	4	26	11	34	59
24	14	16	30	13	1	40	12	32	3
25	15	14	20	13	58	54	13	29	8
26	16	12	9	14	56	6	14	26	4
27	17	9	56	15	53	18	15	23	19
28	18	7	42	16	50	29	16	20	25
29	19	5	25	17	47	40	17	17	31
30	20	3	8	18	44	50	18	14	38
31				19	41	59			

Fourth yeare.	July. ♋			August. ♌			September. ♍		
Day.	Deg.	Mi.	Se.	Deg.	Mi.	Se.	Deg.	Mi.	Se.
1	19	11	45	18	48	58	18	48	46
2	20	8	52	19	46	36	19	47	20
3	21	6	0	20	44	15	20	45	56
4	22	3	9	21	41	56	21	44	33
5	23	0	18	22	39	39	22	43	13
6	23	57	28	23	37	23	23	41	55
7	24	54	38	24	35	8	24	40	39
8	25	51	49	25	32	56	25	39	25
9	26	49	1	26	30	45	26	38	14
10	27	46	13	27	28	35	27	37	5
11	28	43	26	28	26	27	28	35	58
12	29	40	40	29	24	21	29	34	53
13	♌	37	55	♍	22	17	♎	33	50
14	1	35	11	1	20	14	1	32	49
15	2	32	27	2	18	14	2	31	51
16	3	29	45	3	16	15	3	30	54
17	4	27	4	4	14	7	4	30	0
18	5	24	23	5	12	22	5	29	8
19	6	21	44	6	10	28	6	28	19
20	7	19	5	7	8	37	7	27	32
21	8	16	28	8	6	47	8	26	47
22	9	13	52	9	4	59	9	26	4
23	10	11	17	10	3	13	10	25	23
24	11	8	43	11	1	29	11	24	44
25	12	6	10	11	59	46	12	24	7
26	13	3	39	12	58	5	13	23	32
27	14	1	9	13	56	27	14	23	0
28	14	58	40	14	54	50	15	22	30
29	15	56	12	15	53	16	16	22	3
30	16	53	46	16	51	44	17	21	37
31	17	51	21	17	50	14			

Fourth yeare.	October. ♎			November. ♏			December. ♐		
Day.	Deg.	Mi.	Se.	Deg.	Mi.	Se.	Deg.	Mi.	Se.
1	18	21	14	19	26	7	19	55	36
2	19	20	53	20	26	46	20	56	50
3	20	20	33	21	27	27	21	58	5
4	21	20	16	22	28	10	22	59	21
5	22	20	0	23	28	55	24	0	37
6	23	19	48	24	29	41	25	1	54
7	24	19	37	25	30	28	26	3	11
8	25	19	28	26	31	17	27	4	29
9	26	19	22	27	32	7	28	5	47
10	27	19	18	28	32	59	29	7	5
11	28	19	17	29	33	52	♑	8	24
12	29	19	17	♐	34	47	1	9	43
13	♏	19	19	1	35	43	2	11	2
14	1	19	23	2	36	40	3	12	21
15	2	19	29	3	37	39	4	13	40
16	3	19	37	4	38	39	5	14	59
17	4	19	47	5	39	40	6	16	18
18	5	20	0	6	40	42	7	17	37
19	6	20	14	7	41	45	8	18	56
20	7	20	30	8	42	50	9	20	14
21	8	20	48	9	43	55	10	21	33
22	9	21	8	10	45	1	11	22	51
23	10	21	30	11	46	9	12	24	9
24	11	21	54	12	47	17	13	25	27
25	12	22	19	13	48	26	14	26	44
26	13	22	47	14	49	36	15	28	1
27	14	23	16	15	50	47	16	29	18
28	15	23	46	16	51	58	17	30	35
29	16	24	19	17	53	10	18	31	51
30	17	24	53	18	54	23	19	33	7
31	18	25	29				20	34	22

Chap. XXVI.

The vſe of theſe Ephemerides.

OF the vſe of theſe Ephemerides, becauſe they be altogether of the ſame forme, that others generally are, and haue bin heretofore: and to be vſed alſo in all points after the ſame manner, for finding out by them the true place of the Sun at any time deſired, for ſo many yeares as they ſerue: I thinke it needleſſe for me in this place to make any further mention: it being my purpoſe in this booke, rather to make ſupplie of that is wanting in others, then to meddle with that which is by them ſufficiently handled and alreadie publiſhed. This notwithſtanding I thought good to aduertiſe the reader, that theſe Ephemerides, though they be made for fiue yeares only, yet may profitably ſerue for many yeares to come after this manner: Subtract 1612 out of the yeare of Chriſt giuen; diuide that remaineth by foure; if any thing remaine after diuiſion made, it ſheweth which of the three common yeres in theſe Ephemerides anſwereth to the yere giuen: if nothing remaine, the fourth yeare is anſwerable to the yeare giuen. Then ſeeke out the moneth and day of the time giuen both in theſe Ephemerides for that yeare, and in the table of their æquations; and out of them take both the place of the Sun, and the æquation anſwerable to that moneth and day: for the product of this æquation by the quotient, added to the ſaid place of the Sun, if the number of

the

the yeare giuen be more then 1612; or ſubtracted, it it be leſſe, ſhall giue you the true place of the Sunne for the time giuen.

As for example, the 1 of Iuly 1620 ſuppoſe you would know the place of the Sunne: Subtracting therfore 1612 out of 1620, the remainder is 8, which being diuided by 4, the quotient is 2, and nothing remaining; which ſheweth that the fourth yeare (*viz.* 1612) anſwereth to the yeare giuen. Alſo the ſaid moneth and day ſought out in theſe Ephemerides, and in the table of their æquations, giue you the place of the Sun 19 degr. 11 min. 45 ſec. of *Cancer*; and the æquation 1 min. 45 ſec. which multiplie by the quotient 2, make 3 min. 30 ſec. And this added to the ſaid place of the Sun the 1 of Iuly 1612, ſheweth you the true place of the Sun, for the time giuen, to be 19 deg. 15 min. and 15. ſec. of *Cancer*.

Chap. XXVII.

The making of the table of the Suns declination.

THE place of the Sunne being thus eaſily knowne by theſe Ephemerides for euerie day of fiue yeares, the declinations of the Sunne for euery day of the ſame yeares were eaſily found out of the former table of the declination of euery minute of the Ecliptick, in ſuch ſort as was ſhewed in the vſe of that table before ſet downe, chap. 18. pag. 288, and 289: And ſo was made with no leſſe facilitie the table following, of the Sunnes declination for euery day of fiue yeares together, commonly called by Sea-men, *A Regiment of the Sunne.*

Sunne. For although it hath been thought ſufficient in books of Nauigation hitherto publiſhed, to make the regiment of the Sun, or the table of the Sunnes declination for euery day of 4 yeeres, beginning with the firſt yeere after the leape yeere, and ending with the next leape yeere, becauſe the declinations of the Sun for the 4 yeeres following, haue bin ſuppoſed to be the ſame in a manner that they were the 4 yeeres before; and ſo to continue alike, without any notable difference for many yeeres: yet to bring this matter to ſome more certeintie, I haue to this table of declination prefixed the fift yeere alſo, viz. the leap yeere going before the firſt of the ſaid common yeeres; that by comparing the declinations of both leape yeeres together, it might the better appeare what difference of declination there is in euerie 4 yeeres: by addition or ſubtraction of which difference, to the declinations ſet downe in this table; this table may be made to ſerue for a great manie yeeres yet to come, as truely as if it were made of purpoſe for them.

And for the more eaſie and readier vſe of all Seamen, I haue to this end gathered into this little table, the differences of the Sunnes declinations for euery day of the firſt and laſt yeeres ſet down in this table of the Sunnes declinations here following; which differences may be called the proſthaphæreſes, or æquations of the Sunnes declination; becauſe that by adding them to, or ſubtracting them from the declinations conteined in this table, the true declination of the Sunne for any day (though many

many yeeres hence) may eaſily be found; and that after this manner:

Out of the number of the yeere of Chriſt giuen, ſubtract 1612; diuide the remainder by foure, and ſet aſide the quotient; if any thing remaine, that remainder ſheweth in which of the 3 common yeeres you are to ſeeke the Sunnes declination: if nothing remaine, you muſt looke the Sunnes declination in the fourth and laſt yeere, which is leape yeere. Then ſeeke the moneth and day of the time giuen, both in that yeere ſo found in the table of the Sunnes declination, and alſo in this little table of Proſthaphæreſes of the Suns declination here immediatly following; taking out of that the Sunnes declination, and out of this little table the æquation of that declination for foure yeeres; which æquation you ſhal multiply by the ſaid quotient, and adde the product to the declinatiõ found in the table, in the Spring and Autumne; that is, if the Sunne be in *Aries*, *Taurus*, *Gemini*, *Libra*, *Scorpio*, or *Sagittarie*; or ſubtract it in ſummer and winter, *viz.* the Sunne being in *Cancer*, *Leo*, *Virgo*, *Capricorne*, *Aquarie*, or *Piſces*; for ſo ſhall you haue the Sunnes true declination for the time giuen.

Take for example the 15 of March in the yeere of Chriſt 1630: out of this ſubtract 1612, the remainder is 18; which being diuided by 4, the quotient is alſo 4, and 2 remaine; which ſheweth that you muſt ſeeke the Suns declination in the ſecond yeere after the leape yeere, for the moneth and day aforeſaid. Therefore I find the Suns declination in that yeere

(*viz.*

(*viz.*1610) to be 1 deg. 54 min. 16 ſec. & in this little table of Proſthaphæreſes his difference of declination for 4 yeeres, 44 ſec. which multiplied by the foreſaid quotient 4, make 2 min. 56 ſec. to be added to the ſaid declination 1 deg. 54 min. 16 ſec. that ſo you may haue the true declination of the Sunne for that time, *viz.* 1 deg. 57 min. 12 ſec.

Take alſo the 30 of Auguſt, in the yeere of our Lord 1659; out of which, if you ſubtract 1612, there ſhall remaine 47; which being diuided by 4, the quotient will be 11, and 3 remaining. I find therefore in the table of the Sunnes declination, in the third yeere, for the moneth & day aforeſaid, the Sunnes declination 5 deg. 29 min. 35 ſec. Alſo in this little table of Proſthaphæreſes of the Sunnes declination, I find for the ſame moneth and day, the difference of the declination of the Sun for 4 yeeres, to be 42 ſec. which multiplied by the quotient 11, make the product 7 min. 42 ſec. which ſubtracted out of the declination aforeſaid 5 deg. 29 min. 35 ſeconds, ſhall leaue you the Sunnes true declination for the 30 of Auguſt 1659, 5. degr. 21 min. 53 ſec.

Proſtha-

Day.	Ia. Se.	Fe. Se.	M Se.	A. Se.	M Se.	Iu. Se.	Iu. Se.	A. Se.	Se. Se.	O. Se.	N. Se.	D. Se.
1	17	36	42	40	28	8	15	33	42	41	30	9
2	18	37	43	39	28	7	15	34	43	42	29	8
3	19	37	43	40	27	6	16	35	43	42	29	7
4	20	38	44	40	27	5	17	35	43	42	28	6
5	20	37	44	39	26	4	18	34	43	41	28	5
6	21	37	43	39	25	4	19	35	43	41	28	4
7	21	38	43	38	25	3	19	35	44	41	27	3
8	22	39	43	38	24	2	19	35	43	40	26	2
9	24	38	44	38	23	2	20	36	44	40	25	1
10	24	39	45	37	23	1	21	36	43	40	24	1
11	25	39	44	37	22	0	21	37	43	40	24	0
12	25	40	44	37	22	1	22	38	43	39	23	0
13	26	41	43	37	21	1	22	38	43	39	22	1
14	26	40	44	37	20	2	23	38	44	38	21	2
15	27	41	44	35	20	3	23	38	43	38	21	3
16	28	42	43	35	19	4	24	39	44	37	20	4
17	28	41	42	35	19	4	25	39	43	38	20	5
18	29	41	43	35	18	5	26	39	43	37	19	6
19	30	41	43	34	17	6	26	39	43	37	18	7
20	31	42	42	34	17	7	27	40	43	36	17	8
21	31	42	43	33	16	8	27	40	43	36	16	9
22	32	42	43	33	15	8	28	41	44	35	16	10
23	32	43	43	32	14	9	29	40	43	35	15	11
24	32	43	42	32	14	10	29	41	42	34	14	12
25	33	44	42	31	12	11	30	41	43	34	13	12
26	33	44	41	31	12	12	30	41	42	33	13	13
27	34	43	41	30	11	13	30	41	42	34	12	14
28	35	43	41	29	11	13	31	42	42	33	11	15
29	35	43	41	29	9	14	31	41	43	32	11	16
30	35	—	41	29	9	14	32	42	42	32	10	16
31	36		41		8		33	42		31		17

Leape yeare.	*Ianuary.*					*February.*				
	Declinat.			*Differ.*		*Declinat.*			*Differ.*	
Day.	*Deg.*	*Mi.*	*Se.*	*Mi.*	*Se.*	*Deg.*	*Mi.*	*Se.*	*Mi.*	*Se.*
1	21	54	39	9	35	14	7	44	20	11
2	21	45	4	9	59	13	47	33	19	45
3	21	35	5	10	24	13	27	48	21	18
4	21	24	41	10	54	13	6	30	20	52
5	21	13	45	11	7	12	46	38	20	23
6	21	2	38	11	37	12	26	15	20	54
7	20	51	1	12	2	12	5	21	21	6
8	20	38	59	12	24	11	44	15	21	18
9	20	26	35	12	48	11	22	57	21	27
10	20	13	47	13	10	11	1	30	21	39
11	20	0	37	13	34	10	39	51	21	47
12	19	47	3	13	54	10	18	4	21	56
13	19	33	9	14	17	9	56	8	22	7
14	19	18	52	14	24	9	34	1	22	14
15	19	4	28	15	12	9	11	47	22	22
16	18	49	16	15	33	8	49	25	22	31
17	18	33	43	15	26	8	26	54	22	37
18	18	18	17	15	59	8	4	17	22	45
19	18	2	18	16	18	7	41	32	22	50
20	17	46	0	16	38	7	18	42	22	58
21	17	29	22	16	55	6	55	44	23	3
22	17	12	27	17	14	6	32	41	23	8
23	16	55	13	17	31	6	9	33	23	13
24	16	37	42	17	49	5	46	20	23	17
25	16	19	53	18	6	5	23	3	23	22
26	16	1	47	18	21	4	59	41	23	27
27	15	43	26	18	38	4	36	14	23	28
28	15	24	48	18	54	4	12	46	23	32
29	15	5	54	19	9	3	49	14	23	36
30	14	46	45	19	23					
31	14	27	22	19	38					

Leape yeare.	March.				April.			
	Declinat.			Differ.	Declinat.			Differ.
Day.	Deg.	Mi.	Se.	Mi. Se.	Deg.	Mi.	Se.	Mi. Se.
1	3	25	38	23 36	8	34	31	21 52
2	3	2	2	23 38	8	56	23	21 42
3	2	38	24	23 41	9	18	5	21 33
4	2	14	43	23 41	9	39	38	21 25
5	1	51	2	23 43	10	1	3	21 14
6	1	27	19	23 43	10	22	17	21 4
7	1	3	36	23 43	10	43	21	20 53
8	0	39	53	23 42	11	4	14	20 36
9	0	16	11	23 42	11	24	50	20 38
10	0	7	31	23 42	11	45	28	20 20
11	0	31	13	23 39	12	5	48	20 8
12	0	54	52	23 39	12	25	56	19 56
13	1	18	31	23 36	12	45	52	18 43
14	1	42	7	23 34	13	4	35	20 31
15	2	5	41	23 31	13	25	6	19 18
16	2	29	12	23 28	13	44	24	19 4
17	2	52	40	23 24	14	3	28	18 50
18	3	16	4	23 20	14	22	18	18 37
19	3	39	24	23 16	14	40	55	18 22
20	4	2	40	23 12	14	59	17	18 9
21	4	25	52	23 7	15	17	26	17 50
22	4	48	59	23 2	15	35	16	17 38
23	5	12	1	22 58	15	52	54	17 20
24	5	34	59	22 50	16	10	14	17 6
25	5	57	49	22 45	16	27	20	16 49
26	6	20	34	22 37	16	44	9	16 33
27	6	43	11	22 31	17	0	42	16 16
28	7	5	42	22 24	17	16	58	15 58
29	7	28	6	22 16	17	32	56	15 41
30	7	50	22	22 8	17	48	37	15 24
31	8	12	30	22 1				

Leape yeare.	May.					June.				
	Declinat.			Differ.		Declinat.			Differ.	
Day.	Deg.	Mi.	Se.	Mi.	Se.	Deg.	Mi.	Se.	Mi.	Se.
1	18	4	1	15	5	23	11	32	3	50
2	18	19	6	14	48	23	15	22	3	26
3	18	33	54	14	28	23	18	48	3	1
4	18	48	22	14	10	23	21	49	2	38
5	19	2	32	13	51	23	24	27	1	12
6	19	16	23	13	21	23	25	39	2	47
7	19	29	54	13	12	23	28	26	1	23
8	19	43	6	12	52	23	29	49	0	58
9	19	55	58	12	35	23	30	47	0	34
10	20	8	33	12	8	23	31	21	0	9
11	20	20	41	11	49	23	31	30	0	16
12	20	32	30	11	30	23	31	14	0	42
13	20	44	0	11	9	23	30	32	1	5
14	20	55	9	10	8	23	29	27	1	29
15	21	6	7	10	14	23	27	58	1	56
16	21	16	21	10	3	23	26	2	2	19
17	21	26	24	10	42	23	23	43	2	44
18	21	36	6	9	19	23	20	59	3	2
19	21	45	25	8	57	23	17	57	3	39
20	21	54	22	8	34	23	14	18	3	57
21	22	2	56	8	12	23	10	21	3	22
22	22	11	8	7	48	23	4	59	3	45
23	22	18	56	7	25	23	1	14	5	10
24	22	26	21	7	3	22	56	4	5	33
25	22	33	24	6	48	22	50	31	5	57
26	22	40	2	6	15	22	44	34	6	19
27	22	46	17	5	50	22	38	15	6	45
28	22	52	7	5	28	22	31	30	7	8
29	22	57	35	5	3	22	24	22	7	3
30	23	2	38	4	39	22	16	51	7	53
31	23	7	17	4	15					

Leape yeare.	July.				August.			
	Declinat.			Differ.	Declinat.			Differ.
Day.	Deg.	Mi.	Se.	Mi. Se.	Deg.	Mi.	Se.	Mi. Se.
1	22	8	58	8 16	15	14	50	18 3
2	22	0	42	8 39	14	56	47	18 17
3	21	52	3	9 2	14	38	30	18 32
4	21	43	1	9 23	14	19	58	18 47
5	21	33	38	9 45	14	1	11	18 58
6	21	23	53	10 8	13	42	13	19 13
7	21	13	45	10 29	13	23	0	19 24
8	21	3	16	10 50	13	3	36	19 38
9	20	52	26	11 10	12	43	58	19 50
10	20	41	16	11 33	12	24	8	20 1
11	20	29	43	11 53	12	4	7	20 13
12	20	17	50	12 13	11	43	54	20 25
13	20	5	37	12 34	11	23	29	20 36
14	19	53	3	12 53	11	2	53	20 46
15	19	40	10	13 12	10	42	7	20 56
16	19	26	58	13 33	10	21	11	21 6
17	19	13	25	13 51	10	0	5	21 17
18	18	59	34	14 10	9	38	48	21 25
19	18	45	24	14 28	9	17	23	21 34
20	18	30	56	14 47	8	55	49	21 44
21	18	16	9	15 6	8	34	5	21 51
22	18	1	3	15 22	8	12	14	22 0
23	17	45	41	15 40	7	50	14	22 7
24	17	30	1	15 57	7	28	7	22 15
25	17	14	4	16 14	7	5	52	22 21
26	16	57	50	16 31	6	43	31	22 28
27	16	41	19	16 46	6	21	3	22 33
28	16	24	33	17 3	5	58	30	22 43
29	16	7	30	17 18	5	35	47	22 46
30	15	50	12	17 33	5	13	1	22 52
31	15	32	39	17 49	4	50	9	22 58

Leape yeare.	September.				October.			
	Declinat.			Differ.	Declinat.			Differ.
Day.	Deg.	Mi.	Se.	Mi. Se.	Deg.	Mi.	Se.	Mi. Se.
1	4	27	11	23 1	7	12	32	22 43
2	4	4	10	23 6	7	35	15	22 37
3	3	41	4	23 10	7	57	52	22 30
4	3	17	54	23 14	8	20	22	22 23
5	2	54	40	23 18	8	42	45	22 16
6	2	31	22	23 20	9	5	1	22 8
7	2	8	2	23 23	9	27	9	22 0
8	1	44	39	23 26	9	49	9	21 52
9	1	21	13	23 28	10	11	1	21 42
10	0	57	45	23 30	10	32	43	21 33
11	0	34	15	23 30	10	54	16	21 24
12	0	10	45	23 32	11	15	40	21 13
13	0	12	47	23 32	11	36	53	21 3
14	0	36	19	23 33	11	57	56	20 51
15	0	59	52	23 33	12	18	47	20 40
16	1	23	25	23 33	12	39	27	20 27
17	1	46	58	23 31	12	59	54	20 17
18	2	10	29	23 31	13	20	11	20 3
19	2	34	0	23 29	13	40	14	19 50
20	2	57	29	23 28	14	0	4	19 37
21	3	20	57	23 25	14	19	41	19 23
22	3	44	22	23 23	14	39	4	19 7
23	4	7	45	23 20	14	58	11	18 55
24	4	31	5	23 16	15	17	6	18 38
25	4	54	21	23 13	15	35	44	18 23
26	5	17	34	23 9	15	54	7	18 6
27	5	40	43	23 5	16	12	13	17 51
28	6	3	48	22 59	16	30	4	17 34
29	6	26	47	22 55	16	47	38	17 16
30	6	49	42	22 50	17	4	54	16 59
31					17	21	53	16 41

Leape yeare.	*November.*				*December.*			
	Declinat.			*Differ.*	*Declinat.*			*Differ.*
Day.	*Deg.*	*Mi.*	*Se.*	*Mi. Se.*	*Deg.*	*Mi.*	*Se.*	*Mi. Se.*
1	17	38	34	16 23	23	8	20	4 25
2	17	54	57	16 3	23	12	45	3 58
3	18	11	0	15 55	23	16	43	3 30
4	18	26	55	15 14	23	20	13	3 2
5	18	42	9	15 5	23	23	15	2 33
6	18	57	14	14 44	23	25	48	2 6
7	19	11	58	14 23	23	27	54	1 36
8	19	26	21	14 3	23	29	30	1 9
9	19	40	24	13 41	23	30	39	0 39
10	19	54	5	13 18	23	31	18	0 12
11	20	7	23	12 56	23	31	30	0 18
12	20	20	19	12 24	23	31	12	0 46
13	20	32	43	12 21	23	30	26	1 14
14	20	45	4	11 47	23	29	12	1 43
15	20	56	51	11 24	23	27	29	2 11
16	21	8	15	10 59	23	25	18	2 40
17	21	19	14	10 35	23	22	38	3 8
18	21	29	49	10 12	23	19	30	3 36
19	21	40	1	9 44	23	15	54	4 4
20	21	49	45	9 21	23	11	50	4 32
21	21	59	6	8 53	23	7	18	5 1
22	22	7	59	8 29	23	2	17	5 28
23	22	16	28	8 3	22	56	49	5 54
24	22	24	31	7 29	22	50	55	6 23
25	22	32	0	7 17	22	44	32	6 50
26	22	39	17	6 43	22	37	42	7 17
27	22	46	0	6 16	22	30	25	7 43
28	22	52	16	5 48	22	22	42	8 10
29	22	58	4	5 21	22	14	32	8 36
30	23	3	25	4 55	22	5	56	9 2
31					21	56	54	9 27

First yeare.	January.				February.			
	Declinat.			Differ.	Declinat.			Differ.
Day.	Deg.	Mi.	Se.	Mi. Se.	Deg.	Mi.	Se	Mi. Se.
1	21	47	27	9 54	13	52	43	20 2
2	21	37	33	10 19	13	32	41	20 15
3	21	27	14	10 43	13	12	26	20 28
4	21	16	31	11 7	12	51	58	20 40
5	21	5	24	11 33	12	31	18	20 52
6	20	53	51	11 55	12	10	26	21 3
7	20	41	56	12 19	11	49	23	21 15
8	20	29	37	12 41	11	28	8	21 26
9	20	16	56	13 6	11	6	42	21 35
10	20	3	50	13 27	10	45	7	21 45
11	19	50	23	13 49	10	23	22	21 55
12	19	36	34	14 13	10	1	27	22 4
13	19	22	21	14 31	9	39	23	22 12
14	19	7	50	14 54	9	17	11	22 20
15	18	52	56	15 15	8	54	51	22 29
16	18	37	41	15 35	8	32	22	22 35
17	18	22	6	15 53	8	9	47	22 43
18	18	6	13	16 15	7	47	4	22 50
19	17	49	58	16 31	7	24	14	22 55
20	17	33	27	16 52	7	1	19	23 25
21	17	16	35	17 9	6	37	54	22 44
22	16	59	26	17 28	6	15	10	23 12
23	16	41	58	17 44	5	51	58	23 16
24	16	24	14	18 2	5	28	42	23 21
25	16	6	12	18 18	5	5	21	23 25
26	15	47	54	18 34	4	41	56	23 29
27	15	29	20	18 50	4	18	27	23 31
28	15	10	30	19 5	3	54	56	23 34
29	14	51	25	19 19				
30	14	32	6	19 35				
31	14	12	31	19 48				

First yeare	March.		April.	
	Declinat.	Differ.	Declinat.	Differ.
Day.	Deg. Mi. Se.	Mi. Se.	Deg. Mi. Se.	Mi. Se.
1	3 31 22	23 36	8 29 11	21 54
2	3 7 46	23 39	8 51 5	21 46
3	2 44 7	23 40	9 12 51	21 35
4	2 20 27	23 41	9 34 26	21 27
5	1 56 46	23 43	9 55 53	21 16
6	1 33 3	23 42	10 17 9	21 7
7	1 9 21	23 43	10 38 16	20 56
8	0 45 38	23 43	10 59 12	20 44
9	0 21 55	23 42	11 19 56	20 34
10	0 1 47	23 42	11 40 30	20 23
11	0 25 29	23 39	12 0 53	20 11
12	0 49 8	23 39	12 21 4	19 59
13	1 12 47	23 37	12 41 3	19 47
14	1 36 24	23 34	13 0 50	19 34
15	1 59 58	23 32	13 20 24	19 20
16	2 23 30	23 29	13 39 44	19 8
17	2 46 59	23 25	13 58 52	18 54
18	3 10 24	23 21	14 17 46	18 39
19	3 33 45	23 17	14 36 25	18 26
20	3 57 2	23 14	14 54 51	18 11
21	4 20 16	23 8	15 13 2	17 51
22	4 43 24	23 3	15 30 53	17 47
23	5 6 27	22 58	15 48 38	17 26
24	5 29 25	22 52	16 6 4	17 9
25	5 52 17	22 47	16 23 13	16 53
26	6 15 4	22 38	16 40 6	16 37
27	6 37 42	22 34	16 56 43	16 20
28	7 0 16	22 24	17 13 3	16 2
29	7 22 40	22 19	17 29 5	15 46
30	7 44 59	22 10	17 44 51	15 32
31	8 7 9	22 2		

First yeare.	May.				June.			
	Declinat.			Differ.	Declinat.			Differ.
Day.	Deg.	Mi.	Se.	Mi. Se.	Deg.	Mi.	Se.	Mi. Se.
1	18	0	23	15 6	23	10	32	3 57
2	18	15	29	14 52	23	14	29	3 31
3	18	30	21	14 33	23	18	0	3 8
4	18	44	54	14 16	23	21	8	2 43
5	18	59	10	13 53	23	23	51	2 18
6	19	13	3	13 37	23	25	9	2 53
7	19	26	40	13 16	23	28	2	1 29
8	19	39	56	12 57	23	29	31	1 4
9	19	52	53	12 36	23	30	35	0 40
10	20	5	29	12 16	23	31	15	0 15
11	20	17	45	11 55	23	31	30	0 10
12	20	29	40	11 35	23	31	20	0 35
13	20	41	15	11 13	23	30	45	1 0
14	20	52	28	10 52	23	29	45	1 24
15	21	3	20	10 32	23	28	21	2 49
16	21	13	52	10 9	23	25	32	1 13
17	21	24	1	9 47	23	24	19	2 38
18	21	33	48	9 24	23	21	41	3 2
19	21	43	12	9 2	23	18	39	3 28
20	21	52	14	8 41	23	15	11	3 50
21	22	0	55	8 16	23	11	21	4 12
22	22	9	11	7 55	23	7	9	5 44
23	22	17	6	7 30	23	2	25	5 3
24	22	24	36	7 7	22	57	22	5 28
25	22	31	43	6 45	22	51	54	5 53
26	22	38	28	6 20	22	46	3	6 14
27	22	44	48	5 57	22	39	49	6 40
28	22	50	45	5 32	22	33	9	7 1
29	22	56	17	5 9	22	26	8	7 25
30	23	1	26	4 46	22	18	43	7 48
31	23	6	12	4 20				

First yeare.	July.						August.					
	Declinat.			Differ.			Declinat.			Differ.		
Day.	Deg.	Mi.	Se.	Mi.	Se.		Deg.	Mi.	Se.	Mi.	Se.	
1	22	10	55	8	11		15	19	11	18	1	
2	22	2	44	8	34		15	1	10	18	14	
3	21	54	10	8	56		14	42	56	18	28	
4	21	45	14	9	17		14	24	28	18	42	
5	21	35	57	9	40		14	5	46	18	56	
6	21	26	17	10	2		13	46	50	19	9	
7	21	16	15	10	24		13	27	41	20	22	
8	21	5	51	10	45		13	7	19	18	34	
9	20	55	6	11	6		12	48	45	19	48	
10	20	44	0	11	29		12	28	57	19	58	
11	20	32	31	11	47		12	8	59	20	11	
12	20	20	44	12	6		11	48	48	20	22	
13	20	8	38	12	30		11	28	26	20	32	
14	19	56	8	12	48		11	7	54	20	43	
15	19	43	20	13	9		10	47	11	20	55	
16	19	30	11	13	27		10	26	16	21	4	
17	19	16	44	13	47		10	5	12	21	13	
18	19	2	57	14	5		9	43	59	21	23	
19	18	48	52	14	24		9	22	36	21	33	
20	18	34	28	14	42		9	1	3	21	41	
21	18	19	46	15	1		8	39	22	21	49	
22	18	4	45	15	19		8	17	33	21	59	
23	17	49	26	15	36		7	55	34	22	4	
24	17	33	50	15	52		7	33	30	22	14	
25	17	17	58	16	19		7	11	16	22	19	
26	17	1	48	16	36		6	48	57	22	17	
27	16	45	21	16	52		6	26	30	22	33	
28	16	28	38	16	58		6	3	57	22	39	
29	16	11	40	17	15		5	41	18	22	46	
30	15	54	25	17	29		5	18	32	22	50	
31	15	36	56	17	45		4	55	42	22	56	

First yeare.	September.				October.			
	Declinat.			Differ.	Declinat.			Differ.
Day.	Deg.	Mi.	Se.	Mi. Se.	Deg.	Mi.	Se.	Mi. Se.
1	4	32	46	23 1	7	7	0	22 45
2	4	9	45	23 5	7	29	45	22 39
3	3	46	40	23 9	7	52	24	22 31
4	3	23	31	23 14	8	14	55	22 25
5	3	0	17	23 16	8	37	20	22 19
6	2	37	1	23 20	8	59	39	22 9
7	2	13	41	23 22	9	21	48	22 2
8	1	50	19	23 25	9	43	51	21 53
9	1	26	54	23 27	10	5	44	21 45
10	1	3	27	23 29	10	27	29	21 35
11	0	39	58	23 31	10	49	4	21 26
12	0	16	27	23 32	11	10	30	21 16
13	0	7	5	23 32	11	31	46	21 5
14	0	30	37	23 33	11	52	51	20 54
15	0	54	10	23 33	12	13	45	20 43
16	1	17	43	23 31	12	34	28	20 30
17	1	41	14	23 33	12	54	58	20 19
18	2	4	47	23 31	13	15	17	20 7
19	2	28	18	23 30	13	35	24	19 53
20	2	51	48	23 28	13	55	17	19 40
21	3	15	16	23 26	14	14	57	19 26
22	3	38	42	23 23	14	34	23	19 12
23	4	2	5	23 21	14	53	35	18 57
24	4	25	26	23 17	15	12	32	18 42
25	4	48	43	23 14	15	31	14	18 27
26	5	11	57	23 10	15	49	41	18 10
27	5	35	7	23 5	16	7	51	17 55
28	5	58	12	23 1	16	25	46	17 38
29	6	21	13	23 56	16	43	24	17 21
30	6	44	9	22 1	17	0	45	17 3
31					17	17	48	16 45

First yeare.	Nouember.						December.					
	Declinat.			Differ.			Declinat.			Differ.		
Day.	Deg.	Mi.	Se.	Mi.	Se.		Deg.	Mi.	Se.	Mi.	Se.	
1	17	34	33	16	28		23	7	10	4	33	
2	17	51	1	16	7		23	11	43	4	5	
3	18	7	8	15	50		23	15	48	3	37	
4	18	22	58	15	29		23	19	25	3	9	
5	18	38	27	15	10		23	22	34	2	40	
6	18	53	37	14	48		23	25	14	2	12	
7	19	8	25	14	29		23	27	26	1	44	
8	19	22	54	14	7		23	29	10	1	14	
9	19	37	1	13	46		23	30	24	0	48	
10	19	50	47	13	24		23	31	12	0	18	
11	20	4	11	13	2		23	31	30	0	11	
12	20	17	13	12	39		23	31	19	0	39	
13	20	29	52	12	16		23	30	40	1	7	
14	20	42	8	11	53		23	29	33	1	36	
15	20	54	1	11	30		23	27	57	2	4	
16	21	5	31	11	5		23	25	53	2	34	
17	21	16	36	10	42		23	23	19	3	1	
18	21	27	18	10	16		23	20	18	3	29	
19	21	37	34	9	52		23	16	49	3	57	
20	21	47	26	9	25		23	12	52	4	26	
21	21	56	51	9	1		23	8	26	4	54	
22	22	5	52	8	36		23	3	32	5	20	
23	22	14	28	8	8		22	58	12	5	49	
24	22	22	36	7	43		22	52	23	6	16	
25	22	30	19	7	16		22	46	7	6	43	
26	22	37	35	6	50		22	39	24	7	10	
27	22	44	25	6	23		22	32	14	7	37	
28	22	50	48	5	54		22	24	37	8	4	
29	22	56	42	5	26		22	16	33	8	29	
30	23	2	8	5	2		22	8	4	8	56	
31							21	59	8	9	22	

Secõd yeare.	January.				February.			
	Declinat.			Differ.	Declinat.			Differ.
Day.	Deg.	Mi.	Se.	Mi. Se.	Deg.	Mi.	Se.	Mi. Se.
1	21	49	46	9 48	13	57	32	19 59
2	21	39	58	10 11	13	37	33	20 11
3	21	29	47	10 38	13	17	22	20 25
4	21	19	9	11 1	12	56	57	20 37
5	21	8	8	11 26	12	36	20	20 49
6	20	56	42	11 50	12	15	31	21 1
7	20	44	52	12 14	11	54	30	21 11
8	20	32	38	12 36	11	33	19	21 24
9	20	20	2	12 59	11	11	55	21 32
10	20	7	3	13 23	10	50	23	21 54
11	19	53	40	13 44	10	28	29	21 42
12	19	39	56	14 6	10	6	47	22 1
13	19	25	50	14 29	9	44	46	22 11
14	19	11	21	14 47	9	22	35	22 19
15	18	56	34	15 9	9	0	16	22 26
16	18	41	25	15 29	8	37	50	22 35
17	18	25	56	15 51	8	15	15	22 41
18	18	10	5	16 8	7	52	34	22 48
19	17	53	57	16 29	7	29	46	22 54
20	17	37	28	16 46	7	6	52	23 0
21	17	20	42	17 6	6	43	52	23 5
22	17	3	36	17 22	6	20	47	23 11
23	16	46	14	17 41	5	57	36	23 16
24	16	28	33	17 58	5	34	20	23 20
25	16	10	35	18 13	5	11	0	23 4
26	15	52	22	18 31	4	47	56	23 47
27	15	33	51	18 45	4	24	9	23 30
28	15	15	6	19 2	4	0	39	23 34
29	14	56	4	19 16				
30	14	36	48	19 31				
31	14	17	17	19 45				

Secōd yeare.	March.				April.			
	Declinat.			Differ.	Declinat.			Differ.
Day.	Deg.	Mi.	Se.	Mi. Se.	Deg.	Mi.	Se.	Mi. Se.
1	3	37	5	23 36	8	23	52	21 56
2	3	13	29	23 38	8	45	48	21 46
3	2	49	51	23 40	9	7	34	21 39
4	2	26	11	23 41	9	29	13	21 28
5	2	2	30	23 41	9	50	41	21 20
6	1	38	49	23 43	10	12	1	21 9
7	1	15	6	23 43	10	33	10	20 58
8	0	51	23	23 53	10	54	8	20 47
9	0	27	30	23 32	11	14	55	20 37
10	0	3	58	23 41	11	35	32	20 26
11	0	19	43	23 41	11	55	58	20 14
12	0	43	24	23 39	12	16	12	20 2
13	1	7	3	23 38	12	36	14	19 49
14	1	30	41	23 35	12	56	3	19 38
15	1	54	16	23 32	13	15	41	19 24
16	2	17	48	23 29	13	35	5	19 10
17	2	41	17	23 27	13	54	15	18 57
18	3	4	44	23 22	14	13	12	18 43
19	3	28	6	23 18	14	31	55	18 30
20	3	51	24	23 26	14	50	25	18 14
21	4	14	50	23 58	15	8	39	17 59
22	4	37	48	23 4	15	26	38	17 44
23	5	0	52	23 0	15	44	22	17 29
24	5	23	52	22 53	16	1	51	17 14
25	5	46	45	22 48	16	19	5	16 57
26	6	9	33	22 41	16	36	2	16 41
27	6	32	14	22 34	16	52	43	16 24
28	6	54	48	22 27	17	9	7	16 7
29	7	17	15	22 20	17	25	14	16 49
30	7	39	35	22 13	17	41	3	15 33
31	8	1	48	22 44				

Secõd yeare.	May.						June.					
	Declinat.			Differ.			Declinat.			Differ.		
Day.	Deg.	Mi.	Se.	Mi.	Se.		Deg.	Mi.	Se.	Mi.	Se.	
1	17	56	36	15	14		23	9	31	4	2	
2	18	11	50	15	6		23	13	33	3	38	
3	18	26	56	14	30		23	17	11	3	13	
4	18	41	26	14	17		23	20	24	2	50	
5	18	55	43	14	0		23	23	14	2	24	
6	19	9	43	13	41		23	25	38	1	59	
7	19	23	24	13	21		23	27	37	1	35	
8	19	36	45	13	1		23	29	12	1	10	
9	19	49	46	12	41		23	30	22	0	46	
10	20	2	27	12	22		23	31	8	0	21	
11	20	14	49	12	1		23	31	29	0	4	
12	20	26	50	11	38		23	31	25	0	29	
13	20	38	28	11	19		23	30	56	0	54	
14	20	49	47	10	57		23	30	2	1	18	
15	21	0	44	10	37		23	28	44	1	43	
16	21	11	21	10	14		23	27	1	2	7	
17	21	21	35	10	2		23	24	54	2	33	
18	21	31	37	9	20		23	22	21	2	56	
19	21	40	57	8	59		23	19	25	3	21	
20	21	49	56	8	55		23	16	4	3	46	
21	21	58	51	8	22		23	12	18	4	9	
22	22	7	13	8	0		23	8	9	4	34	
23	22	15	13	7	35		23	3	35	4	57	
24	22	22	48	7	14		22	58	38	5	22	
25	22	30	2	6	49		22	53	16	5	45	
26	22	36	51	6	27		22	47	31	6	9	
27	22	43	18	6	2		22	41	22	6	34	
28	22	49	20	5	39		22	34	48	6	56	
29	22	54	59	5	15		22	27	52	7	20	
30	23	0	14	4	51		22	20	32	7	42	
31	23	5	5	4	26							

Secõd yeare.	*Iuly.*					*August.*				
	Declinat.			*Differ.*		*Declinat.*			*Differ.*	
Day.	*Deg.*	*Mi.*	*Se.*	*Mi.*	*Se.*	*Deg.*	*Mi.*	*Se.*	*Mi.*	*Se.*
1	22	12	50	8	5	15	23	30	17	56
2	22	4	45	8	28	15	5	34	18	12
3	21	56	17	8	51	14	47	22	18	24
4	21	47	26	9	13	14	28	58	18	39
5	21	38	13	9	34	14	10	19	18	53
6	21	28	39	9	57	13	51	26	19	6
7	21	18	42	10	18	13	32	20	19	18
8	21	8	24	10	40	13	13	2	19	32
9	20	57	44	11	1	12	53	30	19	44
10	20	46	43	11	22	12	33	46	20	16
11	20	35	21	10	52	12	13	30	19	49
12	20	24	29	12	54	11	53	41	20	17
13	20	11	35	12	24	11	33	24	20	31
14	19	59	11	12	44	11	12	53	20	40
15	19	46	27	13	7	10	52	13	20	52
16	19	33	20	13	18	10	31	21	21	2
17	19	20	2	13	43	10	10	19	21	11
18	19	6	19	14	1	9	49	8	21	21
19	18	52	18	14	19	9	27	47	21	30
20	18	37	59	14	38	9	6	17	21	39
21	18	23	21	14	57	8	44	38	21	48
22	18	8	24	15	13	8	22	50	21	56
23	17	53	11	15	32	8	0	54	22	2
24	17	37	39	15	49	7	38	52	22	12
25	17	21	50	16	6	7	16	40	22	17
26	17	5	44	16	22	6	54	23	22	26
27	16	49	22	16	40	6	31	57	22	31
28	16	32	42	16	54	6	9	26	22	39
29	16	15	48	17	11	5	46	47	22	43
30	15	58	37	17	26	5	24	4	22	50
31	15	41	11	17	41	5	1	14	22	55

Secõd yeare.	September.						October.					
	Declinat.			Differ.			Declinat.			Differ.		
Day.	Deg.	Mi.	Se.	Mi.	Se.		Deg.	Mi.	Se.	Mi.	Se.	
1	4	38	19	22	59		7	1	29	22	47	
2	4	15	20	23	4		7	24	16	22	39	
3	3	52	16	23	8		7	46	55	22	34	
4	3	29	8	23	12		8	9	29	22	26	
5	3	5	56	23	16		8	31	55	22	20	
6	2	42	40	23	19		8	54	15	22	12	
7	2	19	21	23	22		9	16	27	22	3	
8	1	55	59	23	24		9	38	30	21	57	
9	1	32	35	23	27		10	0	27	21	46	
10	1	9	8	23	29		10	22	13	21	38	
11	0	45	39	23	30		10	43	51	21	28	
12	0	22	9	23	32		11	5	19	21	18	
13	0	1	23	23	32		11	26	37	21	8	
14	0	24	55	23	32		11	47	45	20	57	
15	0	48	27	23	33		12	8	42	20	45	
16	1	12	0	23	33		12	29	27	20	34	
17	1	35	33	23	32		12	50	1	20	21	
18	1	59	5	23	32		13	9	22	20	10	
19	2	22	37	23	29		13	30	32	19	57	
20	2	46	6	23	29		13	50	29	19	43	
21	3	9	35	23	26		14	10	12	19	30	
22	3	33	1	23	25		14	29	42	19	15	
23	3	56	26	23	21		14	48	57	19	1	
24	4	19	47	23	18		15	7	58	18	56	
25	4	43	5	23	14		15	26	44	18	30	
26	5	6	19	23	11		15	45	14	18	15	
27	5	29	30	23	7		16	3	29	17	59	
28	5	52	37	23	3		16	21	28	17	41	
29	6	15	40	22	56		16	39	9	17	25	
30	6	38	36	22	53		16	56	34	17	7	
31							17	13	41	16	50	

Secõd yeare.	November.				December.			
	Declinat.			Differ.	Declinat.			Differ.
Day.	Deg.	Mi.	Se.	Mi. Se.	Deg.	Mi.	Se.	Mi. Se.
1	17	30	31	16 32	23	5	0	5 40
2	17	47	3	16 13	23	10	40	4 11
3	18	3	16	15 53	23	14	51	3 44
4	18	19	9	15 34	23	18	35	3 15
5	18	34	43	15 15	23	21	50	2 48
6	18	49	58	14 55	23	24	38	2 18
7	19	4	53	14 32	23	26	56	1 51
8	19	19	25	14 13	23	28	47	1 22
9	19	33	38	13 51	23	30	9	0 54
10	19	47	29	13 30	23	31	3	0 25
11	20	0	59	13 7	23	31	28	0 4
12	20	14	6	12 45	23	31	24	0 32
13	20	26	51	12 21	23	30	52	1 1
14	20	39	12	12 10	23	29	51	1 28
15	20	51	22	11 24	23	28	23	2 58
16	21	2	46	11 12	23	25	25	1 23
17	21	13	58	10 46	23	24	2	2 7
18	21	24	44	10 23	23	21	5	3 23
19	21	35	7	9 57	23	17	42	3 50
20	21	45	4	9 33	23	13	52	4 19
21	21	54	37	9 7	23	9	33	4 47
22	22	3	44	8 41	23	4	46	5 14
23	22	12	25	8 15	22	59	32	5 42
24	22	20	40	7 50	22	53	50	6 10
25	22	28	30	7 23	22	47	40	6 36
26	22	35	53	6 55	22	41	4	7 4
27	22	42	48	6 29	22	34	0	7 30
28	22	49	17	6 2	22	26	30	7 57
29	22	55	19	5 34	22	18	33	8 23
30	23	0	53	4 7	22	10	10	8 50
31					22	1	20	9 16

Third yeare.	January.						February.					
	Declinat.			Differ.			Declinat.			Differ.		
Day.	Deg.	Mi.	Se.	Mi.	Se.		Deg.	Mi.	Se.	Mi.	Se.	
1	21	52	4	9	41		14	2	20	19	55	
2	21	42	23	10	6		13	42	25	20	9	
3	21	32	17	10	31		13	22	16	20	21	
4	21	21	46	10	56		13	1	55	20	35	
5	21	10	50	11	20		12	41	20	20	45	
6	20	59	30	11	44		12	20	35	20	58	
7	20	47	46	12	8		11	59	37	21	10	
8	20	35	38	12	31		11	38	27	21	27	
9	20	23	7	12	54		11	17	0	21	23	
10	20	10	13	13	16		10	55	37	21	41	
11	19	56	57	13	39		10	33	56	21	50	
12	19	43	18	14	1		10	12	6	22	0	
13	19	29	17	14	22		9	50	6	22	7	
14	19	14	55	14	44		9	27	59	22	17	
15	19	0	11	15	4		9	5	42	22	25	
16	18	45	7	15	25		8	43	17	22	32	
17	18	29	42	15	45		8	20	45	22	40	
18	18	13	57	16	4		7	58	5	22	46	
19	17	57	53	16	24		7	35	19	22	53	
20	17	41	29	16	42		7	12	26	22	59	
21	17	24	47	17	1		6	49	27	23	4	
22	17	7	46	17	17		6	26	23	23	10	
23	16	50	29	17	37		6	3	13	23	14	
24	16	32	52	17	53		5	39	59	23	19	
25	16	14	59	18	10		5	16	40	23	23	
26	15	56	49	18	27		4	53	17	23	26	
27	15	38	22	18	42		4	29	51	23	30	
28	15	19	40	18	58		4	6	21	23	33	
29	15	0	42	19	13							
30	14	41	29	19	27							
31	14	22	2	19	42							

Third yeare.	March.				April.			
	Declinat.			Differ.	Declinat.			Differ.
Day.	Deg.	Mi.	Se.	Mi. Se.	Deg.	Mi.	Se.	Mi. Se.
1	3	42	48	23 35	8	18	31	21 58
2	3	19	13	23 38	8	40	29	21 49
3	2	55	35	23 39	9	2	18	21 41
4	2	31	56	23 41	9	23	59	21 31
5	2	8	15	23 42	9	45	30	21 21
6	1	44	33	23 42	10	6	51	21 12
7	1	20	51	23 43	10	28	3	21 1
8	0	57	8	23 43	10	49	4	20 50
9	0	33	25	23 42	11	9	54	20 40
10	0	9	43	23 42	11	30	34	20 28
11	0	13	59	23 41	11	51	2	20 16
12	0	37	40	23 39	12	11	18	20 6
13	1	1	19	23 38	12	31	24	19 52
14	1	24	57	23 36	12	51	16	19 40
15	1	48	33	23 33	13	9	56	19 27
16	2	12	6	23 30	13	30	23	19 15
17	2	35	36	23 27	13	49	38	19 0
18	2	59	3	23 24	14	8	38	18 47
19	3	22	27	23 19	14	27	25	18 32
20	3	45	46	23 15	14	45	57	18 18
21	4	9	1	23 10	15	4	15	18 3
22	4	32	11	23 6	15	22	18	17 48
23	4	55	17	23 1	15	40	6	17 33
24	5	18	18	22 55	15	57	39	17 17
25	5	41	13	22 49	16	14	56	17 1
26	6	4	2	22 42	16	31	57	16 45
27	6	26	44	22 37	16	48	42	16 28
28	6	49	21	22 28	17	5	10	16 11
29	7	11	49	22 22	17	21	21	15 54
30	7	34	11	22 14	17	37	15	15 36
31	7	56	25	22 6				

Third yeare.	May.					June.				
	Declinat.			Differ.		Declinat.			Differ.	
Day.	Deg.	Mi.	Se.	Mi.	Se.	Deg.	Mi.	Se.	Mi.	Se.
1	17	52	51	15	19	23	8	29	4	8
2	18	8	10	15	1	23	12	37	3	43
3	18	23	11	14	42	23	16	20	3	20
4	18	37	53	14	23	23	19	40	2	55
5	18	52	16	14	5	23	22	35	2	30
6	19	6	21	13	45	23	25	5	2	5
7	19	20	6	13	26	23	27	10	1	41
8	19	33	32	13	6	23	28	51	1	16
9	19	46	38	12	47	23	30	7	0	52
10	19	59	25	12	26	23	30	59	0	27
11	20	11	51	12	5	23	31	26	0	2
12	20	23	56	11	45	23	31	28	0	23
13	20	35	41	11	23	23	31	5	0	48
14	20	47	4	11	4	23	30	17	1	11
15	20	58	8	10	41	23	29	6	1	40
16	21	8	49	10	19	23	27	26	1	59
17	21	19	8	9	58	23	25	27	2	26
18	21	29	6	9	35	23	23	1	2	51
19	21	38	41	9	4	23	20	10	3	15
20	21	47	45	9	0	23	16	55	3	39
21	21	56	45	8	28	23	13	16	4	4
22	22	5	13	8	6	23	9	12	4	29
23	22	13	19	7	41	23	4	43	4	51
24	22	21	0	7	19	22	59	52	5	16
25	22	18	19	6	55	22	54	36	5	40
26	22	35	14	6	33	22	48	56	6	2
27	22	41	47	6	8	22	42	54	6	28
28	22	47	55	5	44	22	36	26	6	51
29	22	53	39	5	21	22	29	35	7	14
30	22	59	0	4	56	22	22	21	7	37
31	23	3	56	4	33					

Third yeare	July.						August.					
	Declinat.			Differ.			Declinat.			Differ.		
Day.	Deg.	Mi.	Se.	Mi.	Se.		Deg.	Mi.	Se.	Mi.	Se.	
1	22	14	44	7	59		15	27	48	17	52	
2	22	6	45	8	22		15	9	56	18	7	
3	21	58	23	8	46		14	51	49	18	22	
4	21	49	37	9	7		14	33	27	18	35	
5	21	40	30	9	30		14	14	52	18	50	
6	21	31	0	9	51		13	56	2	19	3	
7	21	21	9	10	13		13	36	59	19	15	
8	21	10	56	10	35		13	17	44	19	29	
9	21	0	21	10	56		12	58	15	19	40	
10	20	49	25	11	17		12	38	35	19	54	
11	20	38	8	11	38		12	18	41	20	4	
12	20	26	30	11	58		11	58	37	20	17	
13	20	14	32	12	18		11	38	20	20	27	
14	20	2	14	12	40		11	17	53	20	39	
15	19	49	34	12	58		10	57	14	20	49	
16	19	36	36	13	18		10	36	25	20	59	
17	19	23	18	13	37		10	15	26	21	9	
18	19	9	41	13	57		9	54	17	21	19	
19	18	55	44	14	15		9	32	58	21	29	
20	18	41	29	14	34		9	11	31	21	38	
21	18	26	55	14	52		8	49	53	21	45	
22	18	12	3	15	9		8	28	8	21	53	
23	17	56	54	15	29		8	6	15	22	2	
24	17	41	25	15	43		7	44	13	22	9	
25	17	25	42	16	2		7	22	4	22	17	
26	17	9	40	16	19		6	59	47	22	23	
27	16	53	21	16	34		6	37	24	22	30	
28	16	36	47	16	51		6	14	54	22	37	
29	16	19	56	17	8		5	52	17	22	42	
30	16	2	48	17	22		5	29	35	22	48	
31	15	45	26	17	38		5	6	47	22	54	

Third yeare.	September.			October.		
	Declinat.		Differ.	Declinat.		Differ.
Day.	Deg.	Mi. Se	Mi. Se	Deg.	Mi. Se.	Mi. Se.
1	4	43 53	22 58	6	55 57	22 48
2	4	20 55	23 3	7	18 45	22 41
3	3	57 52	23 7	7	41 26	22 37
4	3	34 45	23 11	8	4 3	22 27
5	3	11 34	23 15	8	26 30	22 21
6	2	48 19	23 19	8	48 51	22 51
7	2	25 0	23 21	9	10 42	22 29
8	2	1 39	23 24	9	33 11	21 58
9	1	38 15	23 26	9	55 9	21 49
10	1	14 49	23 28	10	16 58	21 39
11	0	51 21	23 31	10	38 37	21 31
12	0	27 50	23 31	11	0 8	21 20
13	0	4 19	23 32	11	21 28	21 10
14	0	19 13	23 32	11	42 38	21 0
15	0	42 45	23 33	12	3 38	20 48
16	1	6 18	23 32	12	24 26	20 37
17	1	29 50	23 33	12	45 3	20 25
18	1	53 23	23 32	13	5 28	20 12
19	2	16 55	23 30	13	25 40	20 0
20	2	40 25	23 28	13	45 40	19 46
21	3	3 53	23 20	14	5 26	19 34
22	3	27 13	23 32	14	25 0	19 19
23	3	50 45	23 22	14	44 19	19 4
24	4	14 7	23 19	15	3 23	18 49
25	4	37 26	23 16	15	22 12	18 34
26	5	0 42	23 12	15	40 46	18 19
27	5	23 54	23 7	15	59 5	18 3
28	5	47 1	23 3	16	17 8	17 46
29	6	10 4	22 59	16	34 54	17 29
30	6	33 3	22 54	16	52 23	17 12
31				17	9 35	16 53

Third yeare.	November.				December.			
	Declinat.			Differ.	Declinat.			Differ.
Day.	Deg.	Mi.	Se.	Mi. Se.	Deg.	Mi.	Se	Mi. Se.
1	17	26	28	16 36	23	4	48	4 47
2	17	43	4	16 18	23	9	35	4 18
3	17	59	22	15 58	23	13	53	3 50
4	18	15	20	15 37	23	17	43	3 23
5	18	30	57	15 22	23	21	6	2 53
6	18	46	19	14 57	23	23	59	1 26
7	19	1	16	14 40	23	25	25	2 58
8	19	15	56	14 18	23	28	23	1 28
9	19	30	14	13 56	23	29	51	1 1
10	19	44	10	13 35	23	30	52	0 32
11	19	57	45	13 12	23	31	24	0 4
12	20	10	57	13 50	23	31	28	0 25
13	20	24	47	11 28	23	31	3	0 54
14	20	36	15	12 4	23	30	9	1 22
15	20	48	19	11 41	23	28	47	1 51
16	21	0	0	11 17	23	26	56	2 19
17	21	11	17	10 53	23	24	37	2 47
18	21	22	10	10 28	23	21	50	3 16
19	21	32	38	10 4	23	18	34	3 44
20	21	42	42	9 38	23	14	50	4 11
21	21	52	20	9 14	23	10	39	4 41
22	22	1	34	8 47	23	5	58	5 1
23	22	10	21	8 22	23	0	57	5 42
24	22	18	43	7 55	22	55	15	6 3
25	22	26	38	7 29	22	49	12	6 30
26	22	34	7	7 3	22	42	42	6 56
27	22	41	10	6 35	22	35	46	7 24
28	22	47	45	6 9	22	28	22	7 52
29	22	53	54	5 41	22	20	30	8 16
30	22	59	35	5 13	22	12	14	8 44
31					22	3	30	9 8

Fourth yeare.	*Ianuary.*					*February.*				
	Declinat.			*Differ.*		*Declinat.*			*Differ.*	
Day.	*Deg.*	*Mi.*	*Se.*	*Mi.*	*Se.*	*Deg.*	*Mi.*	*Se.*	*Mi.*	*Se.*
1	21	54	22	9	36	14	7	8	19	52
2	21	44	46	9	59	13	47	16	20	5
3	21	34	47	10	26	13	27	11	21	19
4	21	24	21	10	50	13	5	52	19	31
5	21	13	31	11	14	12	46	21	20	43
6	21	2	17	11	3	12	25	38	20	55
7	20	51	14	12	37	12	4	43	21	7
8	20	38	37	12	26	11	43	36	21	17
9	20	26	11	12	48	11	22	19	21	28
10	20	13	23	13	11	11	0	51	21	39
11	20	0	12	13	34	10	39	12	21	48
12	19	46	38	13	55	10	17	24	21	57
13	19	32	43	14	17	9	55	27	22	6
14	19	18	26	14	39	9	33	21	22	15
15	19	3	47	14	59	9	11	6	22	23
16	18	48	48	15	20	8	48	43	22	30
17	18	33	28	15	40	8	26	13	22	37
18	18	17	48	16	0	8	3	36	22	45
19	18	1	48	16	19	7	40	51	22	52
20	17	45	29	16	37	7	17	59	22	57
21	17	28	52	16	57	6	55	2	23	49
22	17	11	55	17	14	6	31	13	22	22
23	16	54	41	17	31	6	8	51	23	13
24	16	37	10	17	50	5	45	38	23	19
25	16	19	20	18	6	5	22	19	23	22
26	16	1	14	18	22	4	58	57	23	25
27	15	42	52	18	39	4	35	32	23	29
28	15	24	13	18	54	4	12	3	23	32
29	15	5	19	19	9	3	48	31	23	35
30	14	46	10	19	24					
31	14	26	46	19	38					

Fourth yeare.	March.						April.					
	Declinat.			Differ.			Declinat.			Differ.		
Day.	Deg.	Mi.	Se.	Mi.	Se.		Deg.	Mi.	Se.	Mi.	Se.	
1	3	24	56	23	37		8	35	11	21	51	
2	3	1	19	24	3		8	57	2	21	43	
3	2	37	16	23	17		9	18	45	21	33	
4	2	13	59	23	41		9	40	18	21	24	
5	1	50	18	23	42		10	1	42	21	14	
6	1	26	36	23	43		10	22	56	21	3	
7	1	2	53	23	43		10	43	59	20	53	
8	0	39	10	23	43		11	4	52	20	42	
9	0	15	27	23	44		11	25	34	20	31	
10	0	8	17	23	39		11	46	5	20	20	
11	0	31	56	23	40		12	6	25	20	8	
12	0	55	36	23	38		12	26	33	19	56	
13	1	19	14	23	27		12	46	29	19	43	
14	1	42	41	23	43		13	6	12	19	29	
15	2	6	24	23	31		13	25	41	19	18	
16	2	29	55	23	27		13	44	59	19	4	
17	2	53	22	23	25		14	4	3	18	50	
18	3	16	47	23	20		14	22	53	18	36	
19	3	40	7	23	15		14	41	29	18	22	
20	4	3	22	23	13		14	59	51	18	6	
21	4	26	35	23	7		15	17	57	17	52	
22	4	49	42	23	2		15	35	49	17	36	
23	5	12	44	22	56		15	53	25	17	21	
24	5	35	40	22	51		16	10	46	17	5	
25	5	58	31	22	44		16	27	51	16	49	
26	6	21	15	22	37		16	44	40	16	32	
27	6	43	52	22	31		17	1	12	16	15	
28	7	6	23	22	24		17	17	27	15	58	
29	7	28	47	22	16		17	33	25	15	41	
30	7	51	3	22	8		17	49	6	15	23	
31	8	13	11	22	0							

Fourth yeare.	May.						June.					
	Declinat.			Differ.			Declinat.			Differ.		
Day.	Deg.	Mi.	Se.	Mi.	Se.		Deg.	Mi.	Se.	Mi.	Se.	
1	18	4	29	15	5		23	11	40	3	49	
2	18	19	34	14	47		23	15	29	3	25	
3	18	34	21	14	28		23	18	54	3	0	
4	18	48	49	13	9		23	21	54	2	37	
5	19	2	58	13	50		23	24	31	2	11	
6	19	16	48	13	31		23	26	42	1	48	
7	19	30	19	13	11		23	28	30	1	21	
8	19	43	30	12	51		23	29	51	0	58	
9	19	56	21	12	31		23	30	49	0	33	
10	20	8	52	12	10		23	31	22	0	8	
11	20	21	2	11	50		23	31	30	0	17	
12	20	32	52	11	29		23	31	13	0	42	
13	20	44	21	11	8		23	30	31	1	6	
14	20	55	29	10	46		23	29	25	1	31	
15	21	6	15	10	22		23	27	54	1	55	
16	21	16	37	10	6		23	25	59	2	20	
17	21	26	43	9	40		23	23	39	2	45	
18	21	36	23	9	10		23	20	54	3	10	
19	21	45	33	9	6		23	17	44	3	33	
20	21	54	39	8	33		23	14	11	3	57	
21	22	3	12	8	11		23	10	13	4	22	
22	22	11	23	7	47		23	5	51	4	46	
23	22	19	10	7	25		23	1	5	5	10	
24	22	26	35	7	1		22	55	55	5	35	
25	22	33	36	6	38		22	50	20	5	55	
26	22	40	14	6	14		22	44	24	6	22	
27	22	46	28	5	50		22	38	2	6	45	
28	22	52	18	5	26		22	31	17	7	9	
29	22	57	44	5	3		22	24	8	7	31	
30	23	2	47	4	38		22	16	37	7	54	
31	23	7	25	4	15							

Fourth yeare.	*July.*					*August.*				
	Declinat.			*Differ.*		*Declinat.*			*Differ.*	
Day.	*Deg.*	*Mi.*	*Se.*	*Mi.*	*Se.*	*Deg.*	*Mi.*	*Se.*	*Mi.*	*Se.*
1	22	8	43	8	17	15	14	18	18	5
2	22	0	26	8	39	14	56	13	18	18
3	21	51	47	9	3	14	37	55	18	32
4	21	42	44	9	24	14	19	23	18	46
5	21	33	20	9	46	14	0	37	18	59
6	21	23	34	10	8	13	41	38	19	13
7	21	13	26	10	29	13	22	25	19	26
8	21	2	57	10	51	13	2	59	19	37
9	20	52	6	11	11	12	43	22	19	50
10	20	40	55	11	33	12	23	32	20	2
11	20	29	22	11	55	12	3	30	20	14
12	20	17	27	12	13	11	43	16	20	25
13	20	5	14	12	34	11	22	51	20	36
14	19	52	40	12	53	11	2	15	20	46
15	19	39	47	13	13	10	41	29	20	57
16	19	26	34	13	34	10	20	32	21	3
17	19	13	0	13	52	9	59	29	21	20
18	18	59	8	14	10	9	38	19	21	25
19	18	44	58	14	29	9	16	44	21	35
20	18	30	29	14	48	8	55	9	21	44
21	18	15	41	15	5	8	33	25	21	52
22	18	0	36	15	24	8	11	33	21	59
23	17	45	12	15	40	7	49	34	22	8
24	17	29	32	15	58	7	27	26	22	15
25	17	13	34	16	14	7	5	11	22	21
26	16	57	20	16	31	6	42	50	22	28
27	16	40	49	16	47	6	20	22	22	35
28	16	24	2	17	3	5	57	47	22	41
29	16	6	59	17	19	5	35	6	22	47
30	15	49	40	17	34	5	12	19	22	52
31	15	32	6	17	48	4	49	27	22	58

Fourth yeare.	September.				October.			
	Declinat.			Differ.	Declinat.			Differ.
Day.	Deg.	Mi.	Se.	Mi. Se.	Deg.	Mi.	Se.	Mi. Se.
1	4	26	29	23 2	7	13	13	22 44
2	4	3	27	23 6	7	35	57	22 34
3	3	40	21	23 10	7	58	34	22 30
4	3	17	11	23 14	8	21	4	22 22
5	2	53	57	23 18	8	43	26	22 17
6	2	30	39	23 21	9	5	43	22 8
7	2	7	18	23 22	9	27	51	21 58
8	1	43	56	23 27	9	49	49	21 52
9	1	20	29	23 27	10	11	41	21 42
10	0	57	2	23 29	10	33	23	21 33
11	0	33	33	23 31	10	54	56	21 23
12	0	10	2	23 32	11	16	19	21 13
13	0	13	30	23 33	11	37	32	21 2
14	0	37	3	23 32	11	58	34	20 51
15	1	0	35	23 34	12	19	25	20 39
16	1	24	9	23 32	12	40	4	20 28
17	1	47	41	23 31	13	0	32	20 16
18	2	11	12	23 31	13	20	48	20 3
19	2	34	43	23 29	13	40	51	19 49
20	2	58	12	23 28	14	0	40	19 36
21	3	21	40	23 26	14	20	16	19 23
22	3	45	6	23 22	14	39	39	19 8
23	4	8	28	23 19	14	58	47	18 53
24	4	31	47	23 17	15	17	40	18 38
25	4	55	4	23 12	15	36	18	18 22
26	5	18	16	23 9	15	54	40	18 7
27	5	41	25	23 5	16	12	47	17 50
28	6	4	30	23 0	16	30	37	17 33
29	6	27	30	22 54	16	48	10	17 16
30	6	50	24	22 49	17	5	26	16 58
31					17	22	24	16 41

Fourth yeare.	November.				December.			
	Declinat.			Differ.	Declinat.			Differ.
Day.	Deg.	Mi.	Se.	Mi. Se.	Deg.	Mi.	Se.	Mi. Se.
1	17	39	5	16 21	23	8	28	4 25
2	17	55	26	16 3	23	12	53	3 57
3	18	11	29	15 44	23	16	50	3 29
4	18	27	13	15 24	23	20	19	3 1
5	18	42	37	15 3	23	23	20	2 33
6	18	57	40	14 45	23	25	53	2 4
7	19	12	25	14 23	23	27	57	1 45
8	19	26	48	14 1	23	29	32	1 8
9	19	40	49	13 40	23	30	40	0 39
10	19	54	29	13 18	23	31	19	0 11
11	20	7	47	12 55	23	31	30	0 18
12	20	20	42	12 34	23	31	12	0 48
13	20	33	16	12 9	23	30	24	1 14
14	20	45	25	11 48	22	29	10	1 44
15	20	57	12	11 23	23	27	26	2 13
16	21	8	35	10 59	23	25	13	2 40
17	21	19	34	10 34	23	22	33	3 9
18	21	30	8	10 9	23	19	24	3 37
19	21	40	17	9 46	23	15	47	4 5
20	21	50	3	9 19	23	11	42	4 34
21	21	59	22	8 53	23	7	8	5 0
22	22	8	15	8 28	23	2	8	5 29
23	22	16	43	8 2	22	56	39	5 56
24	22	24	45	7 36	22	50	43	6 23
25	22	32	21	7 9	22	44	20	6 51
26	22	39	30	6 42	22	37	29	7 10
27	22	46	12	6 15	22	30	19	7 52
28	22	52	27	5 48	22	22	27	8 11
29	22	58	15	5 20	22	14	16	8 36
30	23	3	35	4 53	22	5	40	9 3
31					21	56	37	9 26

CHAP.

Chap. XXVIII.

The vſe of the former table, or regiment of the Sunne.

THis table of the Sunnes declinations, as it differeth nothing in forme from others that haue bin publiſhed heretofore: ſo likewiſe the maner of vſing it, is altogether the ſame that hath bin accuſtomed in former tables of this kind, ſauing that I muſt giue warning of one error that hath bin committed herein; which is (as I haue obſerued) that ſome of our ſeamen doe take the Suns declination out of their regiments, without any æquation by addition or ſubtraction of the part proportionall, agreeable to the difference of longitude of the place where they are, as if they were alwaies at the ſame place, or vnder the ſame meridian, for which their regiments were made. For which cauſe alone, (though they auoid all other errors) it may ſo fall out, that they may be deceiued ſometimes 10, or 12 minutes (or more in a long voyage) in taking the Sunnes declination. For there is not any table of the Sunnes declination, but that it muſt needes be made for ſome one meridian (as this former table was made for the meridian of *London*) and therefore cannot be truely vſed in any other, without ſome æquation anſwerable to the diſtance of the meridians, or difference of longitude.

To auoid this error therefore, firſt learne how much you differ in longitude from the place for which

which your table was made, (and though you misse halfe a dozen, or halfe a score degrees herein, it cannot in this point breed any sensible error). Secondly, take out the difference of the Sunnes declination, agreeable to the space of 24 houres, about the time of your obseruation. Thirdly, as 360 is to this difference of declination; so is the difference of longitude to the part proportionall, or æquation of the declination; which æquation is to be added to the declination of the day of obseruation, if the declination of the Sunne be either increasing, and the place of obseruation westward; or else decreasing, and the place of obseruation eastwards from the place for which your table of declination was made: otherwise this æquation is to be subtracted from the declination of your day of obseruation, that you may haue the true declination of the Sunne, for the time and place of your obseruation.

But if the time of your obseruation be the noontide immediatly before or after the Suns entrance into either of the æquinoctiall points, you must follow another rule, and that is this: diuide the difference of longitude by 15, marke how many vnities the quotient conteineth, and so many minutes adde to the declination found in the former table, if you be either eastward from the meridian of *London*, & obserue the noontide before the æquinoctium: or if you be westward from that meridian, and obserue the noontide after the æquinoctiũ, for the sum shall be the declination desired. Otherwise, if you be either westward from the meridian of *London*, and obserue the noonetide next before the æquinoctium,

um, or eaſtward from that meridian, and obſerue the day immediatly after the æquinoctium, compare the declination found in the table with the foreſaid quotient, and ſubtract the leſſer out of the greater, for that remaineth is the declination deſired. Which declination hath the ſame denomination of north or ſouth that the table ſheweth, if the quotient be leſſe then the declination found in the table: but if the quotient be greater, the denomination muſt be altered from north to ſouth, or from ſouth to north, contrary to that the table ſheweth. If the quotient be equall to the declination found in the former table, the Sunne is in the very æquinoctiall point, and hath no declination at all.

A few examples wil make theſe rules more plaine: ſuppoſe therefore the 30 of March 1610, you were ſailing in the bay of *Mexico*, differing in longitude to the weſtwards from the meridian of *London*, about 90 degrees by æſtimation: the declination of the Sunne for that day found in the former table, is 7 degrees, 39 minutes, 35 ſeconds, the difference of the declination in 24 houres at that time, 22 minutes, 13 ſeconds. Now as 360 is to 22 minutes, 13 ſeconds; ſo is 90 degrees to 5 minutes, 33 ſeconds, (the part proportionall or æquation deſired) which becauſe the declination increaſeth, and the bay of *Mexico* is alſo weſtward from the meridian of *London*, muſt be added to the declination before found in the table, and ſo ſhall you haue the true declination of the Sunne that day at noone for that place, 7 degr. 45 min. 8 ſec. But admit you had ſailed eaſtwards, and were in the Eaſt Indian Ocean ſea, differing

ring likewise in longitude frō *London* about 90 deg. therefore the difference of declination, and the part proportionall thereof, or æquation of the declination shall be the same they were before. But because you are gone so much eastwards, the Sunne commeth 6 houres sooner to your meridian there, then it doth to ours here at *London*: and therefore because the declination also is increasing, and will be greater when the Sunne commeth to our meridian then it was, the Sunne being vnder the meridian of the East Indies, that æquation of declination must there be subtracted out of the declination found in the table, which before was to be added when we supposed you to be in the bay of *Mexico*, because the Sunne commeth later by six houres to the meridian of that place, then to ours, and therefore the declination of the Sunne increasing in the meane time, will be greater there then here.

Now imagine you saile in the yeere 1612 through the Streights of Magellane, & hauing passed ouer the south sea, come the 12 of September to the Philippinas, differing in longitude from *London* westwards about 210 degrees.

In this example, because the Sunne is neere the æquinoctiall point (altering his declinatiō about 24 min. in 24 houres, that is, for euery houre one minute) therefore diuide 210 (the difference of longitude) by 15 (the number of degrees contiened in one houre) the quoteint will be 14 minutes (the difference of declination answerable to that difference of longitude.) The declination found in the table for that day is 10 minutes, 2 seconds northerly:

which

which (declination) becauſe it decreaſeth (the Sun not being yet comne to the æquinoctiall) muſt be ſubtracted out of 14, and there ſhall remaine 3 min. 58 ſec. the declination of the Sun that day at noone, for that place. But this declination is ſoutherly, becauſe the quotient 14 min. is greater then 10 min. 2 ſec. the declination found in the table. It would be at this time too tedious for me further to exemplifie euery particularity ſpecified in the former rules, which may cauſe ſome ſmall diuerſitie in the vſe of the Sunnes declination, hauing already giuen examples of the hardeſt caſes that may befall herein, which if they be well conſidered, and eſpecially compared with the Globe or Sphære, (wherein the whole manner of the Sunnes motion and declination may moſt eaſelie, not onely be ſeene, but alſo felt as it were with the fingers ends) the reaſon and demonſtration of all thoſe rules, and of all the diuerſities of working therein ſpecified, may moſt plainly appeare to him that is but of a meane capacitie.

Chap. XXIX.

The declinations of the principall fixed ſtarres about the Æquinoctiall, corrected by obſeruation.

BVt becauſe the declination of the Sun is then only of good vſe for knowing the latitude at ſea, when his meridian altitude may be obſerued: ſo as although all the reſt of the day and night be faire and cleere, if a cloude couer the Sun but one quarter of an houre only, about noone, your tables of the Sunnes decli-

nation will ſtand you in no ſtead: there haue been therefore other meanes deuiſed for attaining to the knowledge of the height of the Pole, not only in particular, by obſeruation of the Pole-ſtar and guards, but alſo in generall by the meridian altitude and declination of any notable fixed ſtarre whatſoeuer. So as not in the day time alone, and that onely at noone, but almoſt at any time of the night, if any ſmall portion of the heauens towards the north or ſouth, appeare but a ſmall time cleere through the raking cloudes, the latitude of the place where you are, may hereby bee more eaſilie knowne, then by obſeruation of the Suns meridian altitude. For to omit the changing of the Sunnes declination from north to ſouth, and from ſouth to north twice in euery yeere, which notwithſtanding breedeth ſome diuerſity of working (by neglect whereof ſome haue groſly erred) the Sunne by reaſon of his ſwiftneſſe of motion, increaſeth or diminiſheth his declination daily, yea hourely, and that very ſenſibly many times, whereof there muſt needs ariſe many ſeuerall conſiderations to be had of the right vſe and application of the Sunnes declination found in the table, as wel in reſpect of the part of declination, (whether it be north or ſouth) as alſo in regard of the difference of longitude betweene the place, for which the tables of the Sunnes declination were made, and the place of obſeruation, whether it be eaſterly or weſterly from thence, beſides many other particularities lately related, and needleſſe here to be repeated. But the fixed ſtarres moouing ſo exceeding ſlowly, that in more then 70 yeeres, they go

not

not ſo much as one degree in their proper motion from the weſt eaſtwards, keep not only the ſame part of the north, or ſouth, but almoſt the ſame point and minute of decliuation for many yeeres together, I meane thoſe ſtarres eſpecially that are placed in the ſignes of *Gemini*, *Cancer*, *Sagitarie*, or *Capricorne*, neere the ſolſtitiall colure, which in an hundred yeeres or two, can alter their declination ſcarce one minute: whereas thoſe ſtarres that bee in *Piſces*, *Aries*, *Virgo*, or *Libra*, eſpecially if they be neere the æquinoctiall colure, may differ in their declinations about one minute in 3 yeeres; which differēce, though it be ſomething, yet for a dozen or twenty yeeres, will hardly be ſo much as can at ſea be obſerued by any inſtrument hitherto had in vſe there.

For theſe two cauſes therefore (that is, for the more eaſie and generall vſe of the declinations of the fixed ſtarres then of the Sun) I wiſh they were more generally knowne and obſerued by our ſeamen then they are, as whereby they might not only moſt eaſily know the eleuation of the Pole at any time of the night, but alſo in any place of the world, much more commodiouſly then otherwiſe they can, becauſe that in what latitude, and how farre ſoeuer they ſhould come either northwards or ſouthwards, they might alwaies haue their choice of diuers fixed ſtarres neere the meridian, both towards the north and ſouth, of a conuenient height to be obſerued. But herewith it were alſo to be wiſhed, that the tables of the fixed ſtarres declinations, which are moſt common amongſt Engliſh mariners, had been more free from error then they are: I meane eſpeci-

ally the tables publiſhed in *Bournes* Regiment, and *Normans* new Attractiue, which (tables agreeing almoſt in euery tittle one with another) ſeeme to be taken word for word one out of another, errors and all; ſo as you cannot finde any error in the one, but you ſhall be ſure alſo to haue the ſame in the other: notwithſtanding ſome of thoſe errors are more then two or three whole degrees, (which becauſe being neglected, or vnknowne to the mariner that ſhall vſe thoſe tables) they may bring him in greater danger then many a hidden rocke vnder ſea: I haue therefore by diligent obſeruation, with a quadrant of more then ſix foote ſemidiameter, detected and corrected thoſe errors, ſhewing not onely the truth to be heedfully followed, but thoſe errors alſo to be as carefully auoided, in ſuch ſort as is ſet downe in the table following, wherein the firſt columne conteineth the names of the ſtarres; the ſecond, the true declinations (as they were found by obſeruation) in degrees and minutes, together with the part of declination, ſignified by the letters N and S, whereof N ſignifieth the declination to be north, and S, ſouth. The third columne containeth the declinations publiſhed in *Bournes* and *Normans* tables. The fourth ſheweth the difference of theſe declinations from the trueth. The fift giueth the right aſcenſions of thoſe ſtarres, reſolued into houres and minutes. In the ſixt and laſt columne are ſet downe the magnitudes or bigneſſe of the ſame ſtarres.

Fixed

The names of the ſtarres.	Declinat. by obſeru.			B. & N. Declin.		Difference.		Right aſcenſ.		Bigneſſe.
	Deg.	Min.		De	Mi.	D.	Mi	Ho.	Mi.	
Whales back	12	20	S	12	11		9	0	50	3
Whales bellie	12	22	S	12	20		2	1	32	3
Rammes horne	17	17	N	17	19		2	1	32	3
Rammes head	21	33	N	21	16		17	1	46	3
Bulles eye	15	38	N	15	42		4	4	13	1
Orions left foote	8	43	S	9	14		29	4	55	1
Orions left ſhoulder.	5	56	N	4	37	1	19	5	4	2
Firſt in Orions girdle.	0	38	S	1	19		41	5	12	2
Orions right ſhoulder.	6	17	N	6	18		1	5	34	1
Great dogge.	16	12	S	15	30		42	6	27	1
Leſſer dogge.	6	13	N	6	4		9	7	18	1
Brighteſt in Hydra	6	53	S	4	47	2	6	9	8	2
Lions heart.	13	55	N	21	59		17	9	57	1
Lions neck	21	52	N	14	3		8	9	46	2
Lions back	22	43	N	22	30		13	10	52	2
Lions taile	16	50	N	16	46		4	11	29	1
Rauens head	20	45	S	19	53		52	11	50	3
Rauens wing.	15	16	S	17	8	1	52	11	56	3
Virgins ſpike	9	0	S	8	53		7	13	5	1
Betwixt Bootes thighs	21	20	N	22	9		49	13	56	1
South Ballance	14	14	S	13	44		30	14	30	2
North Ballance	7	46	S	7	33		13	14	55	2
Scorpions hart.	25	25	S	24	47		38	16	6	1
Hercules head	14	57	N	15	20		23	16	56	3
Serpentaries head	12	57	N	14	7	1	10	17	16	3
Eagles hart	17	54	N	7	28		26	19	32	2
Dolphins taile	10	0	N	10	1		1	20	16	3
Goates taile.	17	51	S	14	13	3	38	21	27	3
Water powrers leg	18	10	S	15	52	2	18	22	35	3
Pegaſus ſhoulder.	12	58	N	13	1		3	22	46	2
Pegaſus leg	25	58	N	26	30		32	22	44	2
Whales taile.	20	12	S	21	47	1	35	0	24	3

Chap. XXX.

The vse of the former Table.

THe declinations of the fixed stars conteined in this table, being to be vsed altogether after the same maner, as the declination of the Sun, for finding out the height of the Pole; it would be but needlesse for me in this place, to write any more of the vse thereof, being a thing so easie and so commonly knowne amongst mariners, and already sufficiently deliuered by others.

Chap. XXXI.

The true distances of certaine principall fixed starres from the north pole, found by late obseruation.

BVt seeing this former table conteineth almost no other stars, but such as are betwixt the tropicks, and neer about the æquinoctiall circle, which are not so fit to be obserued by them that saile farre southwards, or vnder the burnt Zone, (for there they will be too high aboue the horizon) I thought good here to adioine an other table of as many more principall fixed starres (heedfully obserued also with the same quadrant) that are placed neere about the north Pole, which may stand you in as much stead, as twice so many taken out of other parts of the heauens, because they come twice to the meridian aboue our horizon, in euery 24 houres: so as in winter time manie of them may be obserued both euening & morning, twice in one night, both aboue and beneath the Pole. Notwithstanding, for them that saile northwards, it shall be best to obserue these stars when they come to the meridian vnder the

the Pole. Contrariwiſe, they that trauell farre ſouthwards, may beſt obſerue their meridian altitudes aboue the Pole. Herein alſo this table differeth from the former; that whereas in the former were ſet downe the declinations of the ſtars, or their diſtances from the æquinoctiall; in this contrariwiſe are ſet downe the complements of their declinations, or their diſtances from the Pole; whereby the height of the Pole may more eaſily be found, then by their declinations, onely by adding the height of the ſtar obſerued beneath the Pole, to the diſtance thereof from the Pole: or by ſubtracting onely the diſtance of the ſtar from the Pole out of the northerly meridian altitude, obſerued aboue the Pole. But if the meridian altitude of the ſtar be ſoutherly (the ſtarre obſerued being ſouthwards from the Zenith) ſubtract the height of the ſtar from 180, and out of the remainder ſubtract the diſtance of the ſtarre from the Pole; ſo ſhall you haue the height of the Pole: thus alſo there would be a more eaſie way, then that is commonly vſed for knowing the latitude by the Sun or ſtars, hauing ſoutherly declination. For if in ſtead thereof, the complement of declination were ſet downe in the table; the height of the Sun or ſtars alwaies ſubtracted out of this complement, ſhould leaue you the height of the Pole, or latitude deſired.

But to returne to the table of fixed ſtars here following, the firſt columne therein conteineth (as before) the names of the ſtars: the ſecond, their complements of declination, or diſtances from the Pole: the third columne giueth you their right aſcenſions reduced into houres, and minutes of an houre: the fourth ſheweth their bigneſſe or magnitudes.

The

The names of the Starres.	Distance from the Pole.		Right ascension.		Bigneſſe.
	De.	Mi.	Ho.	Mi.	
In the breaſt of Caſſiopeia	35	35	0	19	3
In her lip.	31	26	0	32	3
The Pole ſtarre.	2	52	0	50	3
At the knees of Caſſiopeia.	31	50	1	0	3
In her leg.	28	18	1	25	3
Perſeus right ſhoulder.	38	5	2	35	3
Perſeus right ſide.	41	38	2	56	2
The goate, or wagoners left ſhoulder.	44	30	4	49	1
The wagoners right ſhoulder.	45	11	5	30	2
The firſt in the great beares fore foot	40	30	8	24	3
The ſecond in the ſame foote.	41	28	8	32	3
In her former left knee.	36	37	8	58	3
The great beares ſide.	31	26	10	58	2
The great beares back.	26	5	10	40	2
The end of the Dragons taile.	18	26	11	8	3
The great beares thigh.	34	3	11	32	2
The great beares rump. (taile.	30	41	11	54	2
The next to the end of the Dragons	17	57	12	14	3
The 1 in the great beares taile next	31	49	12	32	2
The middlemoſt in her taile (her rũp.	32	55	13	6	2
In the end of her taile.	38	37	13	32	2
The next before the turning of the	23	40	13	53	3
The formoſt guard. (dragons taile.	14	11	14	54	2
In the turning of the dragons taile.	29	37	15	14	3
The hindmoſt guard.	16	42	15	26	2
Next after the turning of the Dra-	30	20	15	54	3
The Dragons eye. (gons taile.	37	18	17	22	3
The Dragons head.	38	22	17	44	3
In the Swans right wing.	45	44	19	34	3
In her taile.	46	6	20	30	2
Cepheus his right ſhoulder.	29	0	21	10	3
The back of Caſſiopeiaes chaire.	33	2	23	48	3

CHAP. XXXII.

To know at what time any of the foreſaid fixed ſtarres come to the meridian for any day of the yeere.

NOW becauſe the fixed ſtarres are then onely meete to be obſerued for finding the latitude when they are in the meridian; it is therefore good for him that meaneth to obſerue them, to know at what time they come to the meridian. To this end there are tables publiſhed; and almoſt in euery mariners hands, pretending to ſhew at what houre and minute euerie ſtarre in the firſt of theſe two former tables commeth to the meridian, for the beginning and midſt of euerie moneth in the yeere, agreeing likewiſe in euerie error one with another: but becauſe theſe errors breed not (at any time) greater danger or damage to the Mariner that is ware of them, then to make him watch for their comming to the meridian, a quarter, or halfe an houre longer then otherwiſe he needed (this inconuenience only prouided for) thoſe tables may ſerue the turne well enough, for them that liſt not trouble themſelues to learne a better way.

But for them that are deſirous of a more true and generall way, I haue alſo made the table following of the Sunnes right aſcenſions, reduced into houres and minutes (for euery day of this preſent yeere 1599, according to the Ephemerides of the Sunne, before ſet downe: with helpe of which table, it may eaſily be known for any day of any yeere in our age,

at

at what time not onely any of the foreſaid fixed ſtars about the æquinoctiall, but thoſe alſo about the pole, or any other, (whoſe right aſcenſions are knowne in houres and minutes) come to the meridian, and that after this maner. Finde out in the table following the moneth and day wherein you obſerue; the moneth in the vpper margine of the table, the day in the firſt columne thereof next the left hand, the common meeting of the columne deſcending from the moneth, and of the line proceeding from that day towards the right hand, ſhall giue you the Sunnes right aſcenſion in houres and minutes for the ſame day. This right aſcenſion of the Sunne, ſubtract alwaies out of the right aſcenſion of the ſtarre, adding 24 houres to the ſtarres right aſcenſion, if it be leſſe then the right aſcenſion of the Sun: the remainder ſheweth how many houres and minutes after noone, the ſtarre commeth to the vpper part of the meridian; which if they be more then 12 houres, ſubtract 12 from them, and the remainder ſhall ſhew you how many houres and minutes after midnight the ſtar commeth to the vpper part of the meridian. The vpper part of the meridian I call that which paſſeth from the Pole, by the Zenith to the Horizon ſouthwards. But it ſhall be needfull alſo many times when you would obſerue the ſtarres about the Pole (which neuer ſet) to know the time of their comming to the nether part of the meridian, which may eaſily be done, onely by adding twelue houres to the time of their comming to the vpper part of the meridian, if it be leſſe then 12 houres, or by ſubtracting as much if it be more.

Suppoſe

Suppoſe for example, the 25 of Februarie 1599, I would know the time of the great dogs commming to the meridian. Firſt therefore (in the next table) following the columne deſcending from Februarie downewards, and the line proceeding from the 25 day towards the right hand, in the common meeting of them both, I finde 23 houres, 10 min. the Suns right aſcenſion that day at noone. Then in the firſt table of fixed ſtarres, I finde the great dogs right aſcenſion to be 6 degrees, 27 minutes; to which (becauſe it is leſſe then the Suns right aſcenſion) I adde 24 houres, and the ſumme of both commeth to 30 houres, 27 minutes; out of this I ſubtract the Sunnes right aſcenſion, 23 houres, 10 minutes, and there remaine 7 houres, 17 minutes, the time of the great dogs comming to the vpper part of the meridian in the after noone.

Take one example alſo of a ſtarre that neuer ſetteth: and admit the 20 of December the ſame yeere, you would know what time the formoſt guard commeth to the Meridian beneath the Pole: Firſt therefore you ſhall finde, as before, the Sunnes right aſcenſion that day to be 18 houres, 36 minutes: and the right aſcenſion of that ſtarre (in the ſecond table of fixed ſtarres) 14 houres, 54 minutes, to which (being leſſe then the Suns right aſcenſion) adde 24 houres, and from the ſum (38 houres, 24 minutes) ſubtract the Sunnes right aſcenſion 18 houres, 36 minutes: ſo there ſhall remaine 20 houres, 18 minutes, the time of the foreguards comming to the vpper part of the meridian, from which ſubtract 12, ſo you haue the time when it commeth to the nether part of the meridian, 8 houres, 18 minutes after noone.

A Table of the Sunnes right ascension in houres

Day.	Ianuary. Ho.	Mi.	Febru. Ho.	Mi.	March. Ho.	Mi.	Aprill. Ho.	M.	May. Ho.	M.	Iune. Ho.	M.
1	19	30	21	39	23	25	1	18	3	11	5	15
2	19	34	21	43	23	28	1	22	3	15	5	19
3	19	39	21	47	23	32	1	26	3	19	5	25
4	19	43	21	50	23	36	1	29	3	23	5	27
5	19	47	21	54	23	40	1	33	3	27	5	31
6	19	52	21	58	23	44	1	36	3	30	5	36
7	19	56	22	2	23	47	1	40	3	34	5	40
8	20	0	22	6	23	51	1	43	3	38	5	45
9	20	4	22	9	23	55	1	47	3	42	5	49
10	20	8	22	14	23	58	1	51	3	46	5	53
11	20	13	22	18	0	2	1	55	3	50	5	57
12	20	17	22	21	0	6	1	58	3	54	6	1
13	20	22	22	25	0	9	2	2	3	58	6	5
14	20	26	22	29	0	12	2	6	4	3	6	9
15	20	30	22	32	0	16	2	10	4	7	6	13
16	20	34	22	36	0	20	2	14	4	11	6	18
17	20	38	22	40	0	23	2	18	4	15	6	22
18	20	42	22	44	0	27	2	22	4	19	6	36
19	20	46	22	48	0	31	2	26	4	23	6	30
20	20	50	22	52	0	35	2	30	4	27	6	34
21	20	54	22	56	0	38	2	33	4	31	6	38
22	20	58	22	59	0	42	2	37	4	35	6	42
23	21	3	23	3	0	46	2	41	4	39	6	46
24	21	7	23	7	0	49	2	44	4	43	6	51
25	21	11	23	10	0	53	2	48	4	47	6	55
26	21	15	23	14	0	57	2	52	4	51	6	59
27	21	19	23	18	1	0	2	56	4	56	7	3
28	21	23	23	22	1	3	3	0	5	0	7	7
29	21	27			1	7	3	4	5	3	7	11
30	21	31			1	11	3	7	5	7	7	15
31	21	35			1	15			5	11		

and minutes for euery day of the yeare.

	Iuly.	*Aug.*	*Septem.*	*Octob.*	*Nou.*	*Decem.*
Day.	*Ho. M*	*Ho. M.*	*Ho. M.*	*Ho. M.*	*Ho. M.*	*Ho. M.*
1	7 19	9 22	11 16	13 5	15 5	17 12
2	7 23	9 26	11 20	13 8	15 9	17 17
3	7 27	9 30	11 23	13 12	15 13	17 21
4	7 31	9 33	11 27	13 16	15 17	17 25
5	7 35	9 36	11 30	13 19	15 21	17 30
6	7 40	9 40	11 33	13 23	15 25	17 34
7	7 44	9 44	11 37	13 27	15 29	17 39
8	7 48	9 48	11 41	13 31	15 33	17 43
9	7 52	9 52	11 44	13 34	15 37	17 47
10	7 56	9 56	11 48	13 38	15 42	17 52
11	8 0	9 59	11 52	13 42	15 46	17 56
12	8 4	10 3	11 55	13 45	15 50	18 0
13	8 8	10 7	11 59	13 49	15 54	18 5
14	8 12	10 11	12 3	13 53	15 58	18 10
15	8 16	10 15	12 7	13 57	16 3	18 14
16	8 20	10 18	12 11	14 1	16 7	18 18
17	8 24	10 22	12 14	14 5	16 11	18 23
18	8 28	10 26	12 18	14 9	16 16	18 27
19	8 31	10 29	12 22	14 13	16 20	18 32
20	8 35	10 33	12 25	14 17	16 24	18 36
21	8 39	10 36	12 29	14 20	16 28	18 41
22	8 43	10 40	12 32	14 24	16 33	18 45
23	8 47	10 44	12 36	14 28	16 37	18 50
24	8 52	10 47	12 40	14 32	16 41	18 55
25	8 55	10 51	12 43	14 36	16 46	18 59
26	8 59	10 54	12 47	14 40	16 50	19 3
27	9 3	10 58	12 51	14 44	16 55	19 7
28	9 7	11 2	12 54	14 48	16 59	19 12
29	9 11	11 6	12 58	14 53	17 3	19 16
30	9 15	11 9	13 2	14 57	17 8	19 21
31	9 19	11 13		15 1		19 25

Chap. XXXIII.

By the former tables of the fixed ſtarres, and the Sunnes right aſcenſions, to know the houre of the night, at any time of the yeere.

BY theſe tables of fixed ſtarres, and right aſcenſions of the Sunne, you may eaſily know alſo the houre of the night at any time of the yeere, after this maner: looke which of thoſe ſtarres is at the meridian; which may eaſily be knowne by a needle diall or Compaſſe: or if you will obſerue the north ſtarres that neuer ſet, (which indeed are fitteſt for this purpoſe, eſpecially when they come to the meridian vnder the Pole) you ſhall firſt finde the place of the Pole in the heauens, ſo neere as you can by eſtimation (for a little error herein, breakes no ſquare) which may be done thus: From the Pole ſtar directly towards the firſt ſtarre next the rumpe in the Great Beares taile, imagine almoſt ſo much ſpace as the guards are diſtant aſunder, for neere thereabouts is the place of the Pole. Now betwixt your eye, and this place of the Pole, hold a plumbeline hanging as perpendicularly, and ſtedfaſtly as you may, and marke withall if that plumbeline come betwixt your ſight, and any of the ſtarres noted in the table of fixed ſtarres about the Pole; for that ſtarre is at the meridian. Then learne (as before was ſhewed) at what time that ſtar commeth to the meridian, and ſo you ſhall haue the houre of the night.

Suppoſe for example, the 10 of February you finde

finde after this manner the Swans taile at the meridian, vnder the Pole, desiring hereby to know the houre of the night at that time. The right ascension of the Sunne for that day, you shall finde as before, to be 22 houres, 14 minutes, whereto you may adde a minute or two more (because that starre will come to the meridian very late in the euening) so making the Suns right ascension 22 houres, 16 minutes. The right ascension of that starre in the second table of fixed starres, you shall finde to be 20 houres, 30 minutes. From which (because now you desire to know the time of that starres comming to the nether part of the meridian) you may subtract 12 houres, and there shal remaine 8 houres, 30 minutes. To this remainder (because it is lesse then the Suns right ascension) adde 24 houres, and from the sum (32 houres, 30 minutes) subtract the right ascension of the Sunne 22 houres, 16 minutes, so there shall remaine 10 houres, 14 minutes, the time of the night desired.

Chap. XXXIIII.

Of finding the eleuation of the Pole, by obseruation of the pole-starre and guard.

BEsides the waies already spoken of to finde the eleuation of the Pole by the meridian altitudes, and declinations of the Sunne and fixed starres in generall: there hath been also vsed another way more speciall, by the height of the pole-star, when the foreguard is situate from it, either to-

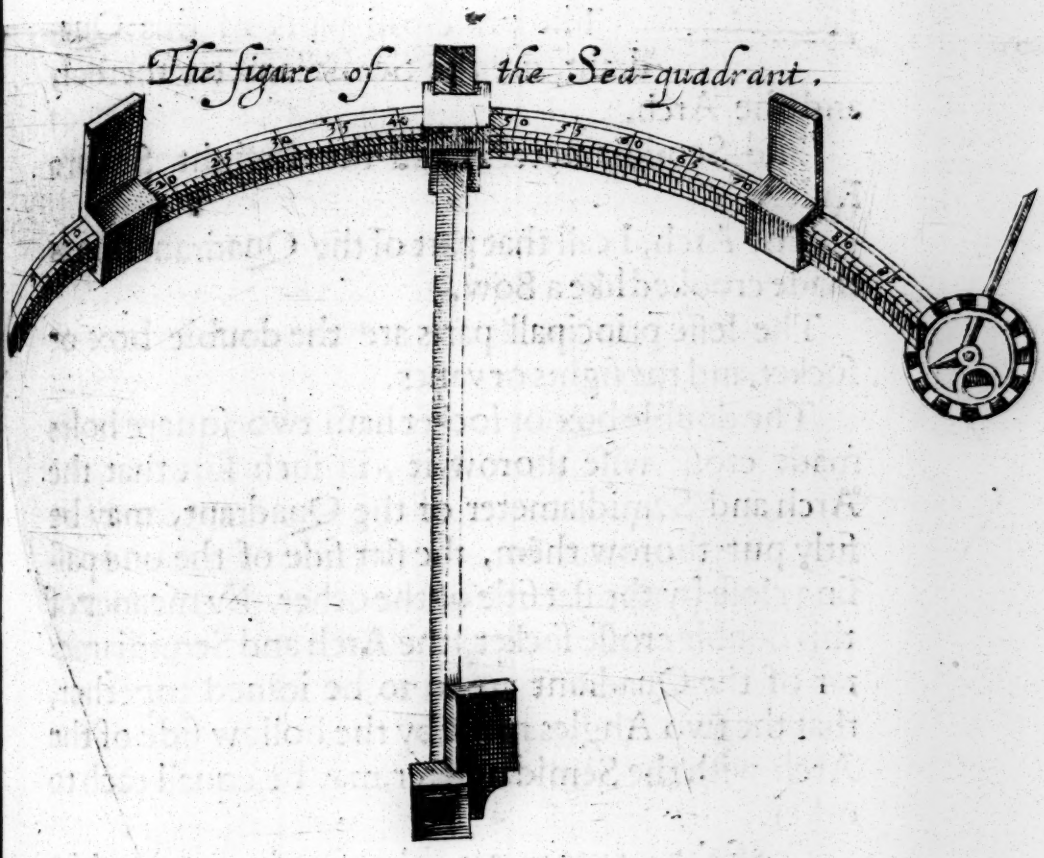
wards the eaſt, weſt, north, or ſouth, or elſe vpon the middle points betwixt theſe principall, as vpon the northeaſt, northweſt, ſoutheaſt, & ſouthweſt points. Of which way, as it hath bin hitherto publiſhed and vſed, I muſt for the preſent onely giue the Mariner warning that he truſt not to it, being very erroneous, and grounded vpon two falſe poſitions. The one is, that the diſtance of the pole-ſtarre from the Pole, is three degrees, 30 minutes, which by often and exact obſeruation, is found to be at this time not aboue 2 deg. 48 min. The other is that the æquations or allowances to be added to, or ſubtracted from the height of the pole-ſtarre, to finde thereby the height of the Pole, are made the ſame for al latitudes.

But hauing already ſhewed ſufficiently how to know the latitude almoſt at any time of the night, by the fixed ſtarres in the former tables, I hope to be the eaſelier excuſed for finding a fault herein, and not amending it at this time, and that ſo much the rather, becauſe that (according to promiſe made in the firſt edition of this booke) I will now ſhew the meanes how by obſeruation of the pole-ſtar and guards, to finde preſently the height of the Pole; not onely when the foreguard is in ſome one of thoſe eight principall poſitions before mentioned, as the manner hath been hitherto; but in any other poſition alſo, and at any time of the night, when the pole-ſtarre and guards may be ſeene, and that without any allowance or abatement, giuing or taking, by addition or ſubtraction of any æquation, in regard of the pole-ſtarres being higher or lower then the Pole. All which, beſides diuers other pleaſant

and

and profitable concluſions, may eaſily bee performed by meanes of an inſtrument by mee deuiſed, which may not vnfitly be called the Sea Quadrant, the deſcription and vſe whereof here followeth.

The figure of the Sea-quadrant.



Chap. XXXVI.

The deſcription and parts of the Sea Quadrant.

THis Quadrant conſiſteth of many parts, whereof ſome may be called principall, and ſome leſſe principall.

The principall parts of this Quadrant, are the Semidiameter thereof, and the Arch.

The Semidiameter I call the ſtreight Square Ruler.

The Arch, I call that part of the Quadrant that is made crooked like a Bow.

The leſſe principall parts are the double box or ſocket, and the ſights or vanes.

The double box or ſocket hath two ſquare holes made croſſe-wiſe thorow it, in ſuch ſort that the Arch and Semidiameter of the Quadrant, may be fitly put thorow them, the flat ſide of the one paſſing cloſe by the flat ſide of the other. By meanes of this double croſſe ſocket, the Arch and Semidiameter of the Quadrant are ſo to be ioined together, that the two Angles made by the hollow ſide of the Arch, with the Semidiameter, may be equall each to other.

The ſights or vanes, are either fixed or moueable.

There be two fixed ſights; the one greater, the other leſſer.

The greater fixed ſight is faſtened vpon the double ſocket, and hath a narrow ſlit cut through the midſt thereof.

The

The leſſer fixed ſight is faſtened to the end of the Arch of the Quadrant, and hath a ſmall ſight hole bored thorow it, euen with the end of the Arch.

The moueable ſights are three in number; whereof two are to be moued vp and downe vpon the Arch of the Quadrant, as need ſhall require for obſeruation. The third is to be put on, or taken off that end of the Semidiameter of the Quadrant where the center is, which center is ſhewed by the little round hole bored ouerthwart thorow the midſt of the thickneſſe of the Square Ruler, neere the end thereof; which Ruler we called the Semidiameter of the Quadrant.

This ſight (whenſoeuer it is to be vſed) muſt ſo be put on vpon the end of that Ruler, that the flat ſide thereof (which muſt be ſet towatds the arch of the Quadrant) may diuide the foreſaid round hole euen by the midſt thereof, the ſharpe edge of that ſight ariſing perpendicularly from the very midſt or center of that hole; which is alſo the center of the Quadrant, whē the other end of the Square Ruler or Semidiameter thereof, being put into his ſocket, is thruſt ſo farre forwards, that the end thereof commeth to be euen with the fore-end of the ſocket.

Two ſides of the arch of the Quadrant, that is to ſay, one of the ſtraight or plaine ſides, and the hollow ſide thereof, are diuided into 90 degrees, and euery degree into 6 parts, each part containing 10 minutes, and vpon the ſtraight ſide of the Quadrant, there be figures ſet to euery fifth degree, and that in two ranks or limbes; the one beginning from that end of the arch, where the ſmall fixed ſight is placed; the

other beginning and proceeding from the other end of the Arch, where the Nocturnall is to be faſtened or put on, that ſo the number of the degrees and minutes might the eaſelier be reckoned from either end of the Arch, as need ſhall require.

Chap. XXXVI.

Of the Nocturnall or Night-diall.

THe Nocturnall conteineth 3 circles; that is, the houre circle, the day circle, and the pole-ſtar circle.

The biggeſt of theſe circles (which is to be faſtened to the end of the Arch of the Quadrant,) I call the houre circle, and it is diuided into 24 houres and halfe houres, with figures ſet to euery houre, for the eaſier reckoning of them.

Next within this is the day circle, or circle of daies, becauſe it conteineth the daies of all the moneths of the yeere; which daies are ſignified by the ſmall diuiſions round about, at the circumference of this circle. Euery fifth day hath his ſtroke drawne a little longer then the reſt, that ſo any day you deſire, may the eaſelier be found. The ſmall diuiſions conteine but one day a peece. The lines ſhewing the beginnings and endings of the moneths, are drawne ouerthwart the whole breadth of this circle. The beginning of Ianuary is knowne by the two lines drawne neere together ouerthwart this circle; whereof one ſheweth the end of the moneth of December, and the other ſheweth the beginning of Ianuarie,

rie, which is marked with two prickes. February is easilie knowne in this circle, because it hath but onely 28 daies. March is by the little pole-star circle: and so all the rest of the moneths may easily be knowne by their order. Vpon the center of this arch, (which representeth the Pole of the world,) there be two Indices fastened: the longer of them may be called the Guard-index, whereto a short pin is fastened vnderneath, which serueth to set this Index right vpon the place of the middle Guard in the day-circle, by putting it into the small hole that there is made in that circle. The shorter Index reaching from the center of the day-circle, vnto the limb or circumference thereof, that is diuided into daies, may be called the Day-index.

This small circle placed betweene the center of the day-circle, and the moneth of March, may not vnfitly be called the Pole-starre circle; because the distance of the center thereof, from the center of the day-circle, is answerable to the distance of the pole-starre from the Pole; which at this time I haue often found by exact obseruation, not to be more then 2 degrees and 48 minutes.

Chap. XXXVII.

The vse of the Sea Quadrant: and that first in obseruing the height of the Sun, looking onely by the sight at the center, to the Horizon at Sea.

TVrne the center of the Quadrant towards the Sunne, so as the shadow of the vane or ight placed at the center may fall vpon the hollow

ſide of the arch of the Quadrant: then looking thorow the little ſight faſtened in the end of the arch of the Quadrant, lay the vpper edge of the ſight placed at the center euen with the Horizon, and at the ſame inſtant let one that ſtandeth by, marke diligently vpon what degree and minute of the Quadrant, the edge of the ſhadow comming from the ſaid edge of the ſight, falleth: for that edge of the ſhadow vpon the hollow ſide of the arch of the Quadrant, ſheweth the height of the vpper edge of the Sunne. From this therefore ſubtract 16 minutes, and ſo much alſo as is anſwerable to the height of your eye aboue the water (in ſuch ſort, as I haue ſhewed in the vſe of the Croſſe-ſtaffe, in the 15 Chapter of this booke,) and ſo you ſhall haue the apparent height of the Sunne aboue the true Horizon.

Chap. XXXVIII.

How with this Quadrant, to obſerue the height of the Sunne, with your backe turned towards the Sunne.

SEt the edge of one of the broad moueable ſights or vanes euen with that end of the Quadrant where the little ſight is fixed. Then looking thorow the ſlit which is made thorow the midſt of the middle ſight that is faſtened to the double box or ſocket, turne your backe toward the ſame, and laying the edge of the vane at the center euen with the Horizon, lift vp, or put downe the arch of the Quadrant, till the vpper edge of the ſhadow of the broad moueable ſight, placed euen with the vpper end of the arch of

of the Quadrant, agree iuſtly with the edge of the ſight or vane placed at the center. Then reckoning frō the vpper end of the arch of the Quadrāt downwards, ſee whar number of degrees and minutes you finde at the vpper edge or end of the ſocket, through which the Quadrant moueth, adding alwaies thereto two degrees; for ſo ſhall you haue the height of the Sunne (if you abate from hence 16 minutes for the Suns Semidiameter) and the ſurpluſſage anſwerable to the height of the eye aboue the water, as before is ſhewed in the former Chapter.

Chap. XXXIX.

How to obſerue with this Quadrant, the height of the Sun or ſtar, looking both to the Sun or ſtar, & to the Horizon.

SEt the vpper edge of the vppermoſt moueable ſight of the Quadrant at ſome euen number of degrees, as at 10, 20, or 30, &c. And ſetting the end of the ſemidiameter of the Quadrant where the center is to the corner of the eye (as you doe when you obſerue with the Croſſe-ſtaffe) lay that edge of the ſight euen with the vpper edge of the Sunne, and moue the nether moueable ſight vp or downe, till the vpper edge thereof lie euen with the Horizon. Then ſee how many degrees and minutes are conteined betweene the vpper edges of both ſights, from which abate as before 16 minutes for the Sunnes ſemidimacter, and the ſurplus anſwerable to the height of your eye aboue the water, ſo ſhall you haue the apparent height of the Sunne aboue the true Horizon. But when you obſerue the height

height of any ſtarres, lay the vpper edge of the vpper ſight, euen with the midſt of the ſtarre, and from the number of degrees and minutes conteined betweene the vpper edges of both ſights, abate onely the ſurplus anſwerable to the height of your eye aboue the water, and ſo you ſhall haue the true height of the ſtarre. But here it muſt be remembred, that before you obſerue the Sunne or ſtarre after this maner, you muſt finde out the eccentricitie of your eye, in ſuch ſort as I haue ſhewed in the 15 Chapter of this booke: which eccentricitie you muſt adde to the diſtance of the center of the Quadrant, from the end of the Semediameter where you ſet your eye: for ſo much as the ſumme of this diſtance and eccentricitie amounteth vnto, ſo much muſt you thruſt forward the fore-end of the Semidiameter of the Quadrant, beyond the further end of the ſquare ſocket thorow which it is put, that ſo the center of your eye may be brought to the center of the Quadrant.

Chap. XL.

How to finde the height of the Pole, by obſeruation of the Pole-ſtarre and Guard, without giuing or taking any ollowance or abatement, at any time when the Pole-ſtarre, the Guard, and Horizon may bee ſeene.

THe long Index of the Nocturnall (which I called the Guard Index) being fixed vpon the place of the middle guard in the day-circle; and the Nocturnall being put vpon the end of

of the arch of the Quadrant, placing alſo the end of the Semidiameter to your eye, as before, and holding the Quadrant vpright, with the Nocturnall towards the pole-ſtar, till the Diameter of the ſemicircular hole of the pole-ſtar circle lie (by eſtimation) æquidiſtant from the Horizon, both ends of the diameter being leuell, or of like height one with another, and ſo keeping the pole-ſtar, ſo neere as you can gueſſe, vpon the midſt of that Diameter, and the fiduciall line of the Guard-index vpon the Guard, moue one of the moueable ſights of the Quadrant vp or downe, till the edge thereof lie euen with the Horizon. Thus therefore the pole-ſtar lying vpon the midſt of the diameter, (that is, vpon the center of the pole-ſtar circle) and the fiduciall line of the Guard index vpon the Guard, and the edge of the ſight euen with the Horizon; the number of degrees and minutes from the end of the Quadrant (where the Nocturnall is placed) to the edge of the ſight, adding thereto fiue degrees, that is, the diſtance of the center of the Nocturnall from the end of the Quadrant, ſhall be the height of the Pole; ſauing that you muſt abate (as before) ſo much as is anſwerable to the height of your eye aboue the water.

To know the houre of the night by the Nocturnall.

AND the point of the ſhort Index (which wee called the Day-index) being firſt ſet to the day of the moneth, ſheweth in the houre-circle, the houre of the night, at the time of your obſeruation.

SIMON STEVIN his errors, in *blaming me of error in my Tables of Rumbes.*

BEfore I end this Treatiſe, I thinke it meete to ſay ſomething for ſatisfaction of the courteous Reader, concerning ſome faults that *Simon Steuin* of late pretẽdeth to finde in my Table of Rumbes, publiſhed in the former edition of my booke of Errors in Nauigation. For not long ſince, there came forth a great volume of Mathematicall Remembrances, gathered and ſet forth by the ſaid *Steuin*, conncerning ſuch points of the Mathematicks; wherein that worthy Generall, Count *Maurice* of Naſſawe, hath for theſe many yeeres ſpent his ſpare houres: whoſe example I wiſh that more of his ranke would follow, for the better inabling them to the diſcharge of their duties. In this volume *Steuin* going about to ſhew diuers wäies for the making of the Table of Rumbes, commeth in the ſecond place to that way which I haue already ſhewed in this booke, Chap. 9. pag. 127. which although he acknowledgeth to be moſt eaſie, and findes no fault with the demonſtrated ground thereof; yet he ſaith, my Tables of Rumbs made according to that way, *haue ſome fault in them: but we ſhall, I make no doubt, finde a greater fault in his fault-finding. Though I neuer durſt preſume to imagine I could ſet forth any thing without

Lib. 4. Geogr. pag. 95.

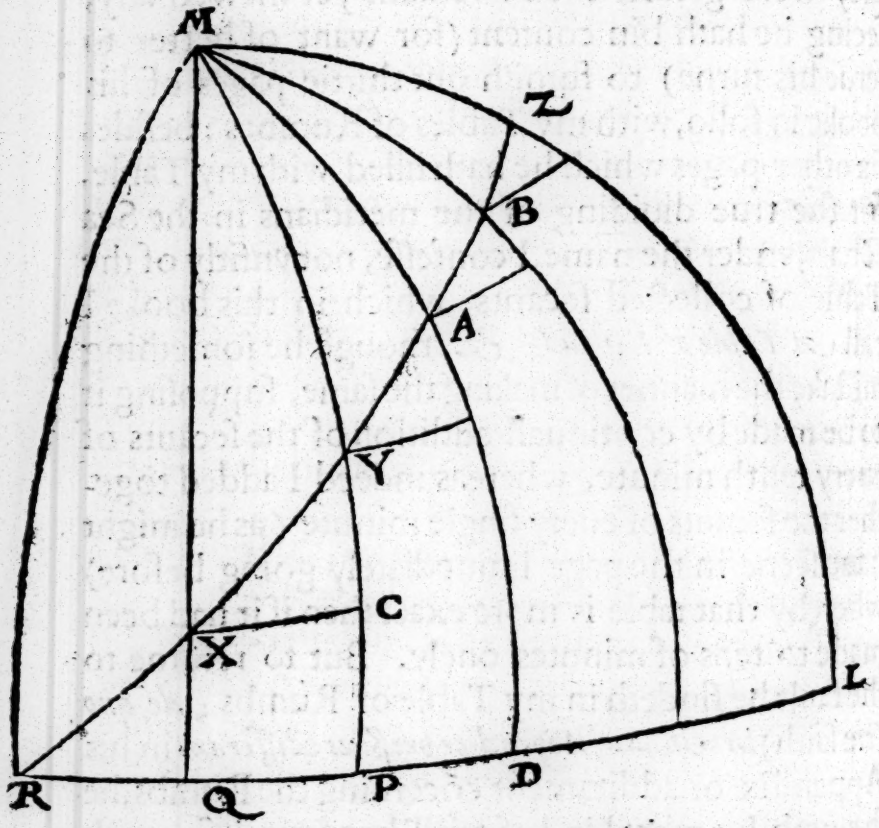
**Quodam vitio laborant. ſed heus tu Nulla ne habes vitia? nò haud non ſtaſſe mi-a.*

without some fault. It sufficeth me if the fault be so little, that it cannot sensibly be discerned; which I hope I shall hereafter shew. But *Steuin* doth here giue vs occasion to expect his Tables of Rumbes, that shal haue no fault in them,* though now he excuse himselfe that he had not leisure to make them. Yet in the meane time he should haue done well (in my opinion) to beare with the faults in mine, except they were greater then hee hath yet shewed any, seeing he hath bin content (for want of better to serue his turne) to furnish out thirtie pages of his booke in folio, with my Tables of Rumbes: besides six other pages which he hath filled with my Table, for the true diuiding of the meridians in the Sea Chart, vnder the name, I confesse, not vnfitly of the Table of collected secants, which in this booke I call *A Table of Latitudes, &c.* though he something mistake the manner of making the same, supposing it to be made by continuall addition of the secants of euery tenth minute, whereas indeed I added together the secants of euery single minute (as he might haue seene in the page immediately going before) whereby that table is more exact then if it had been made to tens of minutes onely. But to returne to the fault he findeth in my Table of Rumbs; *de quo* (he saith) *in* κατοπτρικῷ *Appendice prefsius edisseram* in his Appendix or additament cõcerning the Rumbs, he sheweth by what kind of triall hee found so much fault as he speaketh of in that Table, making proofe of the fourth rumbe, which he might easilieſt doe by addition onely, without any multiplication or diuision, because there the whole sine and tangent of the

*For otherwise he should not haue blamed mine for hauing some fault in them.

rumbs

rumbs angle, (that is, 45 degrees) are æqual, and this trial he maketh according to his first way for the making of the Table of Rumbs, *pag.* 93 and 94, *Lib.* 4. *Geogr.* by the solution of a right angled sphæricall triangle, wherein (beside the right angle) there is giuen the angle of the rumbe, with the side adiacent to both those angles. As in the triangle *R Q X* hauing giuen the angle at *Q*, being a right angle, and



that at *R* 45 degrees, with the side *R Q* 11 degrees, he findeth the side *Q X* 59 minutes, 59 seconds, the latitude of the fourth rumbe for one degree of longitude. Then drawing *X C* parallel to *Q P*, so that *C P* may be æquall to *Q X*, he resolueth in like maner

ner the triangle *Y C X*, supposing the angle at *C* and *X* æquall to those at *Q* and *R*, and the side *X C*, æquall to a degree of the parallel at that latitude 59 minutes, 58 seconds, (but more truely 59 seconds) whereby he findeth the side *C Y* (in like manner as before) 59 minutes, 57 seconds, (but more truely 58 seconds) which added to *P C*, 59 minutes, 59 seconds, shall make *P Y* 1 degree, 59 minutes, 56 seconds, as he saith; but more truely it should be 1 degree, 59 minutes, 57 seconds, the latitude of that rumbe for two degrees of longitude: & thus he proceedeth in al the rest till he come to 78 degrees of longitude, (where he saith) he found the latitude of that rumbe to be 61 degrees, 26 minutes, my table hauing no more but 61 degrees, 14 minutes, and so the difference of latitude arising to no more then 12 minutes for so great a longitude as 78 degrees. And yet he saith, *Certis rationibus cognorat*, he certainely knew that the true latitude must needs be lesse then 61 degrees, 26 minutes, which was to him no small argument, that my table of rumbes came very neere the trueth, though it hit not the naile on the head (as they say). Surely therefore Master *Steuin* might haue eased me of some trouble, and haue saued himselfe some labour & reputation, both if he had spared his paines in seeking to find fault with me for so mall a matter, whereby Nauigators could incurre neither damage nor danger, although mine error were so much as he supposeth For (in the practise of Nauigation) what inconueniencie can arise to the Sea-man by such an error as shall cause him to goe wide of his course no more then 12 minutes, in sailing so farre that he must

first

first alter his longitude 78 degrees, and his latitude 61 degrees and more: but the truth is, vpon due triall, (yea euen according to *Steuins* owne way) this error will not be found so much as a minute; and to assure my selfe and others thereof, I tooke the paines to examine throughout the ground of my Table of rumbs, that is, the table of latitudes, or collected secants before set downe, newly calculating the same twice ouer for euery minute, with the helpe of two calculators, alwaies comparing their calculations together, that when any difference chanced betwixt them, they might still finde and amend their fault (if they chanced to make any) before they proceeded any further therein; and by comparing these newly calculated tables with my former, I could not any where finde such difference as could breed any sensible error. Then something to satisfie Master *Steuins* desire (becausse he accounteth not his table of the 8 rumbe taken out of *Appian*, exact enough, shewing onely how many minutes and seconds of a degree of the æquinoctiall, one degree of each parallel conteineth for euery halfe degree of latitude, and that not truely sometimes, as I haue tried: I haue therefore newly and more exactly calculated such a table to minutes, seconds, and thirds, and that for euery 10 minutes of latitude. I made also the like table, to shew how many minutes, seconds, and thirds of one degree of the æquinoctial, answere to 10 minutes of each parallel for euery 10 minutes of latitude. By the first of these tables, I made triall what latitude the fourth rumbe would haue at 78 degrees of longitude, proceeding as *Steuin* did by whole degrees, accor-

cording to his first way of making the table of rumbes, and found the latitude not much aboue a minute lesse then his (*viz.*) 61 degrees, 24 minutes, 44 seconds, which difference might partly arise from the imperfection of the foresaid table of *Appian*, which it seemeth he followed in his calculation. Then by helpe of the second of these tables, I made the like triall for euery 10 minutes of longitude, and so found the latitude of that rumbe at 78 degrees of longitude to be 61 degrees, 15 minutes, 42 seconds, 40 thirds, which also must needes bee greater then the true latitude thereof at that place, by the very same reasons whereby *Steuin* saith, hee knew certainely that the true latitude was lesse then 61 degrees 26 minutes: so then the true latitude of that rumbe for that longitude, must needs be lesse then 61 degrees, 15 minutes, 43 seconds: therefore by *Steuins* owne rule more fitly applied, my table of rumbes accounting that latitude to be no more then 61 degrees 14 minutes, shall not erre so much as two minutes. Yet indeede more exactly it would rather haue been 61 degrees 15 minutes: for to set it downe more scrupulously (according to the way I then followed in making that table) it should be 61 degrees, 14 minutes, 41 seconds. But the trueth is, I did not then purpose, nor care to be so curious, thinking it would be sufficient, if my table of rumbes erred not any where so much as a minute in the latitude of any rumbe; which by this triall already made, I assure my selfe they doe not.

Wherein also I am the more confirmed by the like triall I haue made of the first rumbe (counted

from the meridian) though *Simon Steuin* in his solemne demonstration continued almost in three whole pages in * folio (wherein he professeth that *the scope or marke he aimeth at, is to demonstrate that my table of rumbs is erroneous*) would make the world beleeue that my table erreth aboue two minutes in the latitude of that rumbe, before I come to so little as two degrees of longitude. But the truth is, he much mistaketh the matter, the error being indeede in his owne grosse manner of triall, much more then in my table: for working after his owne way by whole degrees, as he doth, it falleth out euen so as he saith, that the latitude of that rumbe for two degrees of longitude will be aboue 2 minutes greater then my table hath. But if he worke the very same way by sixth parts of degrees, or tennes of minutes, he shall finde but little aboue halfe a minute more then is in my table of rumbes. Nay moreouer, if it shall please him at his leisure to take the paines to make triall hereof to euery single minute, he shall not finde so much as one second more then my account giueth. For following the very same way that he prescribeth for the true making of the table of rumbes in his λοξοδρομίας Appendice pag. 154, 155. and so calculating the latitude of the first rumbe for euery single minute of longitude, the latitude of that rumbe for two degrees of longitude, shall be found to be not so much as 10 degrees 0 mi. 14 sec. 46 third. which latitude according to my manner of making my table of rumbes, is not so little as 10 degr. 0 min. 13 sec. 47 third. differing not so much as one second from the former. But according to M. *Steuins* ac-

*Pag. 153. 154. 155.

count

count by whole degrees, it should be 10 degr. 2 min. 6. seconds, exceeding the truth of both the foresaid accounts almost two minutes in latitude, before he be come to so little as two degrees in longitude, and so grossely erring himselfe, whilest he too vnaduisedly, and without iust cause indeuoreth to publish to the world my supposed errors. Which that it may the more manifestly appeare, either to him, or to any other that shall be disposed to make triall, as I haue done, I haue here set downe the particular account hereof in the tables following.

By whole degrees, the first rumbes

Longitude.	*Latitude.*
De. M.	*Deg. Mi. Se.*
1 0	5 1 38
2 0	10 2 6

By tens of minutes, the first rumbes

Longitude.	*Latitude.*
De. Mi.	*D. g. Mi. Se. Th.*
0 10	0 50 16 23
0 20	1 40 32 26
0 30	2 30 47 33
0 40	3 21 1 5
0 50	4 11 12 16
1 0	5 1 20 46
1 10	5 51 25 35
1 20	6 41 26 18
1 30	7 31 22 14
1 40	8 21 12 38
1 50	9 10 57 0
2 0	10 0 34 40

The first table, accounting by whole degrees, as *Steuin* doth, sheweth the latitude of the first rumbe for two degrees of longitude to be tenne degrees, two min. six seconds. Whereas the second table accounting by tennes of minutes, giueth it to be no more thē ten degrees, 0 min. 34. seconds, 40 thirds. And the third by single min. findeth but 10 degrees, 0 min. 14 seconds, 45 thirds, 21 fourths.

By single minutes, the first rumbes						*By single minutes, the first rumbes*					
Lõgitude		*Latitude.*				*Lõgitude*		*Latitude.*			
Deg.	*Mi.*	*Deg.*	*mi.*	*Se.*	*Th.four.*	*Deg.*	*Mi.*	*Deg.*	*mi.*	*Se.*	*Th.four.*
0	1	0	5	1	38 25	0	31	2	35	47	48 29
0	2	0	10	3	16 50	0	32	2	40	49	8 18
0	3	0	15	4	55 10	0	33	2	45	50	26 56
0	4	0	20	6	33 25	0	34	2	50	51	44 14
0	5	0	25	8	11 30	0	35	2	55	53	0 17
0	6	0	30	9	49 25	0	36	3	0	54	14 59
0	7	0	35	11	27 10	0	37	3	5	55	28 21
0	8	0	40	13	4 40	0	38	3	10	56	40 17
0	9	0	45	14	41 50	0	39	3	15	57	50 48
0	10	0	50	16	18 40	0	40	3	20	58	59 48
0	11	0	55	17	55 10	0	41	3	26	0	7 18
0	12	1	0	19	31 15	0	42	3	31	1	14 3
0	13	1	5	21	6 55	0	43	3	36	2	18 22
0	14	1	10	22	42 4	0	44	3	41	3	21 6
0	15	1	15	24	16 43	0	45	3	46	4	22 9
0	16	1	20	25	50 47	0	46	3	51	5	21 26
0	17	1	25	27	24 15	0	47	3	56	6	19 3
0	18	1	30	28	57 4	0	48	4	1	7	14 49
0	19	1	35	30	29 12	0	49	4	6	8	8 45
0	20	1	40	32	0 40	0	50	4	11	9	0 50
0	21	1	45	33	31 22	0	51	4	16	9	51 0
0	22	1	50	35	1 14	0	52	4	21	10	39 14
0	23	1	55	36	30 16	0	53	4	26	11	25 27
0	24	2	0	37	58 28	0	54	4	31	12	9 39
0	25	2	5	39	25 53	0	55	4	36	12	51 51
0	26	2	10	40	52 14	0	56	4	41	13	31 57
0	27	2	15	42	17 45	0	57	4	46	14	9 53
0	28	2	20	43	42 5	0	58	4	51	14	45 37
0	29	2	25	45	5 20	0	59	4	56	15	19 11
0	30	2	30	46	27 30	1	0	5	1	15	50 29

By single minutes, the first rumbes						By single minutes, the first rumbes					
Lõgitude		Latitude.				Lõgitude		Latitude.			
Deg.	Mi.	Deg.	mi.	Se.	Th. four.	Deg.	Mi.	Deg.	mi.	Se.	Th. four.
1	1	5	6	16	19 32	1	31	7	36	9	56 9
1	2	5	11	16	46 14	1	32	7	41	8	55 28
1	3	5	16	17	10 35	1	33	7	46	7	51 20
1	4	5	21	17	32 30	1	34	7	51	6	43 41
1	5	5	26	17	52 0	1	35	7	56	5	32 26
1	6	5	31	18	8 59	1	36	8	1	4	17 34
1	7	5	36	18	23 27	1	37	8	6	2	59 7
1	8	5	41	18	35 19	1	38	8	11	1	36 58
1	9	5	46	18	44 40	1	39	8	16	0	11 8
1	10	5	51	18	51 20	1	40	8	20	58	41 32
1	11	5	56	18	55 20	1	41	8	25	57	8 5
1	12	6	1	18	56 38	1	42	8	30	55	30 51
1	13	6	6	18	55 11	1	43	8	35	53	49 46
1	14	6	11	18	50 58	1	44	8	40	52	4 45
1	15	6	16	18	43 54	1	45	8	45	50	15 48
1	16	6	21	18	33 59	1	46	8	50	48	22 54
1	17	6	26	18	21 13	1	47	8	55	46	25 59
1	18	6	31	18	5 31	1	48	9	0	44	25 3
1	19	6	36	17	46 48	1	49	9	5	42	20 1
1	20	6	41	17	25 4	1	50	9	10	40	10 52
1	21	6	46	17	0 9	1	51	9	15	37	57 36
1	22	6	51	16	31 28	1	52	9	20	35	40 9
1	23	6	56	16	0 31	1	53	9	25	33	18 26
1	24	7	1	15	26 23	1	54	9	30	30	52 27
1	25	7	6	14	49 4	1	55	9	35	28	22 11
1	26	7	11	14	8 34	1	56	9	40	25	47 34
1	27	7	16	13	24 48	1	57	9	45	23	8 40
1	28	7	21	12	37 41	1	58	9	50	20	25 20
1	29	7	26	11	47 13	1	59	9	55	17	37 34
1	30	7	31	10	53 24	2	0	10	0	14	45 21

A Table of the eigth rumbe.

Latitude.	Ten min. of longitude.	Difference.	Latitude.	Ten min. of longitude.	Difference.
De. Mi.	min. sec. thir.	sec. thir.	De. Mi.	min. sec. thir.	sec. thir.
0 10	10 0 0	0 0	5 10	9 57 34	0 9
0 20	9 59 59	0 1	5 20	9 57 24	0 10
0 30	9 59 59	0 0	5 30	9 57 14	0 10
0 40	9 59 58	0 1	5 40	9 57 4	0 10
0 50	9 59 56	0 2	5 50	9 56 54	0 10
1 0	9 59 54	0 2	6 0	9 56 43	0 11
1 10	9 59 52	0 2	6 10	9 56 32	0 11
1 20	9 59 50	0 2	6 20	9 56 20	0 12
1 30	9 59 48	0 2	6 30	9 56 9	0 11
1 40	9 59 45	0 3	6 40	9 55 57	0 12
1 50	9 59 41	0 4	6 50	9 55 44	0 13
2 0	9 59 38	0 3	7 0	9 55 32	0 12
2 10	9 59 34	0 4	7 10	9 55 19	0 13
2 20	9 59 30	0 4	7 20	9 55 6	0 13
2 30	9 59 26	0 4	7 30	9 54 52	0 14
2 40	9 59 21	0 5	7 40	9 54 38	0 14
2 50	9 59 16	0 5	7 50	9 54 24	0 14
3 0	9 59 11	0 5	8 0	9 54 10	0 14
3 10	9 59 5	0 6	8 10	9 53 55	0 15
3 20	9 58 59	0 6	8 20	9 53 40	0 15
3 30	9 58 53	0 6	8 30	9 53 25	0 15
3 40	9 58 46	0 7	8 40	9 53 9	0 16
3 50	9 58 40	0 6	8 50	9 52 53	0 16
4 0	9 58 32	0 8	9 0	9 52 37	0 16
4 10	9 58 26	0 6	9 10	9 52 20	0 17
4 20	9 58 17	0 9	9 20	9 52 3	0 17
4 30	9 58 9	0 8	9 30	9 51 46	0 17
4 40	9 58 1	0 8	9 40	9 51 29	0 17
4 50	9 57 52	0 9	9 50	9 51 11	0 18
5 0	9 57 43	0 9	10 0	9 50 53	0 18

A Table of the eigth rumbe.

Latitude.	Ten min. of longitude.	Difference.	Latitude.	Ten min. of longitude.	Difference.
De. Mi.	min. sec. thir.	sec. thir.	De. Mi.	min. sec. thir.	sec. thir.
10 10	9 50 35	0 18	15 10	9 39 6	0 27
10 20	9 50 16	0 19	15 20	9 38 39	0 27
10 30	9 49 57	0 19	15 30	9 38 11	0 28
10 40	9 49 37	0 19	15 40	9 37 43	0 28
10 50	9 49 18	0 20	15 50	9 37 14	0 29
11 0	9 48 59	0 19	16 0	9 36 46	0 28
11 10	9 48 39	0 20	16 10	9 36 16	0 30
11 20	9 48 18	0 21	16 20	9 35 47	0 29
11 30	9 47 57	0 21	16 30	9 35 18	0 29
11 40	9 47 36	0 22	16 40	9 34 48	0 30
11 50	9 47 15	0 21	16 50	9 34 17	0 31
12 0	9 46 53	0 22	17 0	9 33 47	0 30
12 10	9 46 31	0 22	17 10	9 33 16	0 31
12 20	9 46 9	0 22	17 20	9 32 45	0 31
12 30	9 45 47	0 22	17 30	9 32 14	0 31
12 40	9 45 24	0 23	17 40	9 31 42	0 32
12 50	9 45 1	0 23	17 50	9 31 9	0 33
13 0	9 44 37	0 24	18 0	9 30 38	0 31
13 10	9 44 14	0 23	18 10	9 30 4	0 34
13 20	9 43 50	0 24	18 20	9 29 33	0 31
13 30	9 43 25	0 25	18 30	9 29 0	0 33
13 40	9 43 1	0 24	18 40	9 28 26	0 34
13 50	9 42 36	0 25	18 50	9 27 53	0 33
14 0	9 42 11	0 25	19 0	9 27 19	0 34
14 10	9 41 45	0 26	19 10	9 26 45	0 34
14 20	9 41 19	0 26	19 20	9 26 10	0 35
14 30	9 40 53	0 26	19 30	9 25 35	0 35
14 40	9 40 27	1 26	19 40	9 25 0	0 35
14 50	9 40 0	1 27	19 50	9 24 25	0 35
15 0	9 39 33	0 27	20 0	9 23 49	0 36

A Table of the eigth rumbe.

Latitude.	Ten min. of longitude.	Difference.	Latitude.	Ten min. of longitude.	Difference.
De. Mi.	min. sec. thir.	sec. thir.	De. Mi.	min. sec. thir.	sec. thir.
20 10	9 23 13	0 36	25 10	9 3 3	0 44
20 20	9 22 37	0 36	25 20	9 2 18	0 45
20 30	9 22 0	0 37	25 30	9 1 33	0 45
20 40	9 21 23	0 37	25 40	9 0 48	0 45
20 50	9 20 46	0 37	25 50	9 0 2	0 46
21 0	9 20 9	0 37	26 0	8 59 17	0 45
21 10	9 19 31	0 38	26 10	8 58 31	0 46
21 20	9 18 53	0 38	26 20	8 57 44	0 47
21 30	9 18 15	0 38	26 30	8 56 58	0 46
21 40	9 17 37	0 38	26 40	8 56 11	0 47
21 50	9 16 58	0 39	26 50	8 55 24	0 47
22 0	9 16 19	0 39	27 0	8 54 36	0 48
22 10	9 15 39	0 40	27 10	8 53 49	0 47
22 20	9 15 0	0 39	27 20	8 53 1	0 48
22 30	9 14 20	0 40	27 30	8 52 12	0 49
22 40	9 13 40	0 40	27 40	8 51 24	0 48
22 50	9 12 59	0 41	27 50	8 50 35	0 49
23 0	9 12 18	0 41	28 0	8 49 46	0 49
23 10	9 11 37	0 41	28 10	8 48 57	0 49
23 20	9 10 56	0 41	28 20	8 48 7	0 50
23 30	9 10 14	0 42	28 30	8 47 17	0 50
23 40	9 9 32	0 42	28 40	8 46 27	0 50
23 50	9 8 50	0 42	28 50	8 45 37	0 50
24 0	9 8 8	0 42	29 0	8 44 46	0 51
24 10	9 7 25	0 43	29 10	8 43 55	0 51
24 20	9 6 42	0 43	29 20	8 43 4	0 51
24 30	9 5 59	0 43	29 30	8 42 13	0 51
24 40	9 5 15	0 44	29 40	8 41 21	0 52
24 50	9 4 31	0 44	29 50	8 40 29	0 52
25 0	9 3 47	0 44	30 0	8 39 37	0 52

A Table of the eigth rumbe.

Latitude.	Ten min. of longitude.	Difference.	Latitude.	Ten min. of longitude.	Difference.
De. Mi.	min. sec. thir.	sec. thir.	De. Mi.	min. sec. thir.	sec. thir.
30 10	8 38 44	0 53	35 10	8 10 29	1 1
30 20	8 37 52	0 52	35 20	8 9 29	1 0
30 30	8 36 59	0 53	35 30	8 8 28	1 1
30 40	8 36 5	0 54	35 40	8 7 27	1 1
30 50	8 35 12	0 53	35 50	8 6 26	1 1
31 0	8 34 18	0 54	36 0	8 5 25	1 1
31 10	8 33 24	0 54	36 10	8 4 23	1 2
31 20	8 32 30	0 54	36 20	8 3 21	1 2
31 30	8 31 35	0 55	36 30	8 2 19	1 3
31 40	8 30 40	0 55	36 49	8 1 17	1 2
31 50	8 29 45	0 55	36 50	8 0 14	1 3
32 0	8 28 50	0 55	37 0	7 59 11	1 3
32 10	8 27 54	0 56	37 10	7 58 8	1 3
32 20	8 26 58	0 56	37 20	7 57 4	1 4
32 30	8 26 2	0 56	37 30	7 56 1	1 3
32 40	8 25 6	0 56	37 40	7 54 57	1 4
32 50	8 24 9	0 57	37 50	7 53 53	1 4
33 0	8 23 12	0 57	38 0	7 52 48	1 5
33 10	8 22 15	0 57	38 10	7 51 44	1 4
33 20	8 21 18	0 57	38 20	7 50 39	1 5
33 30	8 20 20	0 58	38 30	7 49 34	1 5
33 40	8 19 22	0 58	38 40	7 48 29	1 5
33 50	8 18 24	0 58	38 50	7 47 23	1 6
34 0	8 17 25	0 59	39 0	7 46 17	1 6
34 10	8 16 27	0 58	39 10	7 45 11	1 6
34 20	8 15 28	0 59	39 20	7 44 5	1 6
34 30	8 14 29	0 59	39 30	7 42 59	1 6
34 40	8 13 29	1 0	39 40	7 41 52	1 7
34 50	8 12 29	1 0	39 50	7 40 45	1 7
35 0	8 11 30	0 59	40 0	7 39 38	1 7

A Table of the eigth rumbe.

Latitude.	Ten min. of longitude.	Difference.	Latitude.	Ten min. of longitude.	Difference.
De. Mi	min. sec. thir.	sec. thir.	De. Mi.	min. sec. thir.	sec. thir.
40 10	7 38 30	1 8	45 10	7 3 2	1 14
40 20	7 37 23	1 7	45 20	7 1 47	1 15
40 30	7 36 15	1 8	45 30	7 0 33	1 14
40 40	7 35 7	1 8	45 40	6 59 18	1 15
40 50	7 33 58	1 9	45 50	6 58 3	1 15
41 0	7 32 48	1 10	46 0	6 56 48	1 15
41 10	7 31 41	1 7	46 10	6 55 32	1 16
41 20	7 30 32	1 9	46 20	6 54 17	1 15
41 30	7 29 22	1 10	46 30	6 53 1	1 16
41 40	7 28 13	1 9	46 40	6 51 45	1 16
41 50	7 27 3	1 10	46 50	6 50 29	1 16
42 0	7 25 53	1 10	47 0	6 49 12	1 17
42 10	7 24 43	1 10	47 10	6 47 55	1 17
42 20	7 23 33	1 10	47 20	6 46 38	1 17
42 30	7 22 22	1 11	47 30	6 45 21	1 17
42 40	7 21 11	1 11	47 40	6 44 4	1 17
42 50	7 20 0	1 11	47 50	6 42 47	1 17
43 0	7 18 49	1 11	48 0	6 41 29	1 18
43 10	7 17 37	1 12	48 10	6 40 11	1 18
43 20	7 16 26	1 11	48 20	6 38 53	1 18
43 30	7 15 14	1 12	48 30	6 37 34	1 19
43 40	7 14 1	1 13	48 40	6 36 16	1 18
43 50	7 12 49	1 12	48 50	6 34 57	1 19
44 0	7 11 36	1 13	49 0	6 33 38	1 19
44 10	7 10 23	1 13	49 10	6 32 19	1 19
44 20	7 9 10	1 13	49 20	6 31 0	1 19
44 30	7 7 57	1 13	49 30	6 29 40	1 20
44 40	7 6 44	1 13	49 40	6 28 20	1 20
44 50	7 5 30	1 14	49 50	6 27 1	1 19
45 0	7 4 16	1 14	50 0	6 25 40	1 21

A Table of the eigth rumbe.

Latitude.	*Ten min. of longitude.*	*Difference.*	*Latitude.*	*Ten min. of longitude.*	*Difference.*
De. Mi.	*min. sec. thir.*	*sec. thir.*	*De. Mi.*	*min. sec. thir.*	*sec. thir.*
50 10	6 24 20	1 20	55 10	5 42 43	1 26
50 20	6 23 0	1 20	55 20	5 41 17	1 26
50 30	6 21 39	1 21	55 30	5 39 51	1 26
50 40	6 20 18	1 21	55 40	5 38 24	1 27
50 50	6 18 57	1 21	55 50	5 36 58	1 26
51 0	6 17 36	1 21	56 0	5 35 31	1 27
51 10	6 16 14	1 22	56 10	5 34 4	1 27
51 20	6 14 52	1 22	56 20	5 32 37	1 27
51 30	6 13 31	1 21	56 30	5 31 10	1 27
51 40	6 12 9	1 22	56 40	5 29 42	1 28
51 50	6 10 46	1 23	56 50	5 28 15	1 27
52 0	6 9 24	1 22	57 0	5 26 47	1 28
52 10	6 8 1	1 23	57 10	5 25 16	1 28
52 20	6 6 38	1 23	57 20	5 23 51	1 28
52 30	6. 5 15	1 23	57 30	5 22 23	1 28
52 40	6 3 52	1 23	57 40	5 20 54	1 29
52 50	6 2 29	1 23	57 50	5 19 26	1 28
53 0	6 1 5	1 24	58 0	5 17 57	1 29
53 10	5 59 42	1 23	58 10	5 16 28	1 29
53 20	5 58 18	1 24	58 20	5 14 59	1 29
53 30	5 56 54	1 24	58 30	5 13 30	1 29
53 40	5 55 29	1 25	58 40	5 12 1	1 29
53 50	5 54 5	1 24	58 50	5 10 31	1 30
54 0	5 52 40	1 25	59 0	5 9 1	1 30
54 10	5 51 16	1 24	59 10	5 17 5	1 29
54 20	5 49 51	1 25	59 20	5 6 2	1 30
54 30	5 48 25	1 26	59 30	5 4 31	1 31
54 40	5 47 0	1 25	59 40	5 3 1	1 30
54 50	5 45 35	1 25	59 50	5 1 31	1 30
55 0	5 44 9	1 26	60 0	5 0 0	1 31

A Table of the eigth rumbe.

Latitude.	Ten min. of longitude.	Difference.	Latitude.	Ten min. of longitude.	Difference.
De. Mi	min. sec. thir.	sec. thir.	De. Mi.	min. sec. thir.	sec. thir.
60 10	4 58 29	1 31	65 10	4 11 59	1 35
60 20	4 56 58	1 31	65 20	4 10 24	1 35
60 30	4 55 22	1 31	65 30	4 8 49	1 35
60 40	4 53 56	1 31	65 40	4 7 17	1 35
60 50	4 52 25	1 31	65 50	4 5 38	1 35
61 0	4 50 53	1 32	66 0	4 4 3	1 35
61 10	4 49 22	1 31	66 10	4 2 27	1 36
61 20	4 47 50	1 32	66 20	4 0 51	1 36
61 30	4 46 18	1 32	66 30	3 59 15	1 36
61 40	4 44 46	1 32	66 40	3 57 39	1 36
61 50	4 43 13	1 33	66 50	3 56 3	1 36
62 0	4 41 41	1 32	67 0	3 54 26	1 37
62 10	4 40 9	1 32	67 10	3 52 50	1 36
62 20	4 38 36	1 33	67 20	3 51 53	1 37
62 30	4 37 3	1 33	67 30	3 49 37	1 36
62 40	4 35 30	1 33	67 40	3 48 0	1 37
62 50	4 33 57	1 33	67 50	3 46 23	1 37
63 0	4 32 42	1 33	68 0	3 44 46	1 37
63 10	4 30 50	1 34	68 10	3 43 9	1 37
63 20	4 29 17	1 33	68 20	3 41 32	1 37
63 30	4 27 43	1 34	68 30	3 39 44	1 38
63 40	4 26 9	1 34	68 40	3 38 17	1 37
63 50	4 24 36	1 33	68 50	3 36 39	1 38
64 0	4 23 1	1 35	69 0	3 35 1	1 37
64 10	4 21 27	1 34	69 10	3 33 24	1 38
64 20	4 19 53	1 34	69 20	3 31 46	1 38
64 30	4 18 18	1 35	69 30	3 30 8	1 38
64 40	4 16 44	1 34	69 40	3 28 9	1 39
64 50	4 15 9	1 35	69 50	3 26 51	1 38
65 0	4 13 14	1 35	70 0	3 25 13	1 38

A Table of the eigth rumbe.

Latitude.	*Ten min. of longitude.*	*Difference.*	*Latitude.*	*Ten min. of longitude.*	*Difference.*
De. Mi.	*min. sec. thir.*	*sec. thir.*	*De. Mi.*	*min. sec. thir.*	*sec. thir.*
70 10	3 23 14	1 39	75 10	2 33 36	1 42
70 20	3 21 56	1 38	75 20	2 31 59	1 41
70 30	3 20 17	1 39	75 30	2 30 14	1 41
70 40	3 18 38	1 39	75 40	2 28 32	1 42
70 50	3 16 59	1 39	75 50	2 26 51	1 41
71 0	3 15 21	1 38	76 0	2 25 9	1 42
71 10	3 13 41	1 40	76 10	2 23 28	1 41
71 20	3 12 0	1 38	76 20	2 21 46	1 42
71 30	3 10 23	1 40	76 30	2 20 4	1 42
71 40	3 8 44	1 39	76 40	2 18 22	1 42
71 50	3 7 4	1 40	76 50	2 16 50	1 42
72 0	3 5 25	1 39	77 0	2 14 58	1 42
72 10	3 3 45	1 40	77 10	2 13 16	1 42
72 20	3 2 5	1 40	77 20	2 11 34	1 42
72 30	3 0 25	1 40	77 30	2 9 52	1 42
72 40	2 58 46	1 39	77 40	2 8 10	1 42
72 50	2 57 6	1 40	77 50	2 6 27	1 43
73 0	2 55 25	1 41	78 0	2 4 45	1 42
73 10	2 53 45	1 40	78 10	2 3 2	1 43
73 20	2 52 5	1 40	78 20	2 1 20	1 42
73 30	2 50 25	1 40	78 30	1 59 37	1 43
73 40	2 48 44	1 41	78 40	1 57 55	1 42
73 50	2 47 4	1 40	78 50	1 56 12	1 43
74 0	2 45 23	1 41	79 0	1 54 29	1 43
74 10	2 43 42	1 41	79 10	1 52 46	1 43
74 20	2 42 2	1 40	79 20	1 51 3	1 43
74 30	2 40 20	1 42	79 30	1 49 21	1 42
74 40	2 38 40	1 40	79 40	1 47 38	1 43
74 50	2 36 59	1 41	79 50	1 45 55	1 43
75 0	2 35 18	1 41	80 0	1 44 11	1 44

A Table of the eigth rumbe.

Latitude.	*Ten min. of longitude.*	*Difference.*	*Latitude.*	*Ten min. of longitude.*	*Difference.*
De. Mi.	*min. sec. thir.*	*sec. thir.*	*De. Mi.*	*min. sec. thir.*	*sec. thir.*
80 10	1 42 28	1 43	85 10	0 50 33	1 45
80 20	1 40 45	1 43	85 20	0 48 49	1 44
80 30	1 39 0	1 43	85 30	0 47 5	1 44
80 40	1 37 18	1 44	85 40	0 45 20	1 45
80 50	1 35 35	1 44	85 50	0 43 36	1 44
81 0	1 33 52	1 43	86 0	0 41 51	1 45
81 10	1 32 8	1 44	86 10	0 40 7	1 44
81 20	1 30 25	1 43	86 20	0 38 22	1 45
81 30	1 28 41	1 44	86 30	0 36 38	1 44
81 40	1 26 58	1 43	86 40	0 34 53	1 45
81 50	1 25 14	1 44	86 50	0 33 9	1 44
82 0	1 23 40	1 44	87 0	0 31 24	1 45
82 10	1 21 57	1 43	87 10	0 29 40	1 44
82 20	1 20 3	1 44	87 20	0 27 55	1 45
82 30	1 18 19	1 44	87 30	0 26 10	1 45
82 40	1 16 35	1 44	87 40	0 24 26	1 44
82 50	1 14 51	1 44	87 50	0 22 41	1 45
83 0	1 13 7	1 44	88 0	0 20 56	1 45
83 10	1 11 23	1 44	88 10	0 19 12	1 44
83 20	1 9 39	1 44	88 20	0 17 27	1 45
83 30	1 7 55	1 44	88 30	0 15 42	1 45
83 40	1 6 11	1 44	88 40	0 13 58	1 44
83 50	1 4 27	1 44	88 50	0 12 13	1 45
84 0	1 2 43	1 44	89 0	0 10 28	1 45
84 10	1 0 59	1 44	89 10	0 9 44	1 44
84 20	0 59 15	1 44	89 20	0 6 59	1 45
84 30	0 57 31	1 44	89 30	0 5 14	1 45
84 40	0 55 46	1 44	89 40	0 3 29	1 45
84 50	0 54 2	1 44	89 50	0 1 45	1 44
85 0	0 52 18	1 44	90 0	0 0 0	

This table of the eigth rumbe, shewing the quantitie of 10 minutes of longitude at euery 10 minutes of latitude, in minutes, seconds, and thirds of one degree of the æquinoctial, I thought good here to adioyne for their sakes that may peraduenture be desirous by themselues to make triall of that I haue before written, concerning the grosse and rude manner of examination, which *Simon Steuin* vseth to make the world beleeue that my table of rumbes is so much erroneous as he saith, and after his fashion would seeme to demonstrate. And lest any should suspect that this table also may be as faultie as *Steuin* would perswade vs the other is, I haue thought good here to shew the way how I made the same, that if any list take so much paines, he may either examine and correct this if neede shall be, or make a new one if he will, which may be done after this manner, and by this rule: What proportion the whole sine hath to the sine of the latitudes complement; the same proportion hath one sixth part of a degree of the æquinoctiall, that is, 10 minutes, which make 36000 thirds, to the number of the same thirds of a degree of the æquinoctiall, contained in 10 minutes of longitude at the same latitude, which being diuided by 60, the remainder shall be the thirds remaining besides minutes and seconds, and this first quotient being againe diuided by 60, the second quotient shall bee the minutes, and the remainder thereof the seconds. For example, suppose you would finde the quantitie of 10 minutes of a degree in the parallell, whose latitude is 10 degrees; now the complement of this latitude is 80 degrees, the sine whereof

is

is 9848,078, the whole sine being 10,000,000: and as this whole sine is to the sine aforesaid, so is 36,000 (that is, the number of thirds that are in ten minutes of the æquinoctiall) to 35,453, that is, the number of the same thirds contained in ten min. of a degree of the said parallel. And these thirds diuided by 60, giue in the quotient 590 sec. and 53 thirds remaining; and 590 diuided again by 60, the quotient is 9 min. and the remainder 50 seconds. So then, the quantitie of ten min. of longitude at ten degr. of latitude, shall be 9 min. 50 sec. 53 thirds of one degree of the æquinoctial. And thus was made the whole table.

The making of the table of Rumbes.

Now by help of this table of the eigth rumbe, the preceding table of the first rumb next the meridian, and all the rest may thus be made: As the whole sine, is to the tangent of the rumbes angle with the æquinoctiall; so is one minute of the æquinoctiall to the latitude of the same rumbe for one minute of longitude. And so is a minute of longitude (found out by this table of the eigth rumbe) at that latitude, to the difference of latitude; which added to the former latitude, giueth the latitude of ỹ same rumb, for two minutes of longitude: and againe at this latitude, a minute of longitude (found by the same table) shall haue the same proportion to the difference of latitude; which added to the latitude of the same rumb for two minutes of longitude, sheweth the latitude of that rumbe for three minutes of longitude. And after this manner proceeding in all the rest, you may make vp ỹ whole table of rumbs.

FINIS.

THE DIVISION OF THE WHOLE

Art of Nauigation.

THE whole Art of Nauigation, which teacheth vs to saile by courses and by heights, is diuided into two principall parts; the Theoricke, and the Practicke. The Theoricke teacheth the composition of the Sphære of the world in generall; and in particular informeth vs of the number, figure, and motions of the heauens, especially of the highest moueable heauen, called Primum Mobile, and of the ninth, eighth, fourth, and first heauen: also it sheweth vs the quantitie and situation of the elements, and principally of the earth and water; and the circles which are imagined to be in that Sphære; without the knowledge of which, it is impossible to be a Nauigator. The Practicke part teacheth the making and vse of those instruments which are vsed in Nauigation, as namely the Astrolabe, the Crosse-staffe, the Sea-compasse, and the Diall, with the Regiment of the Sunne, and of the starre, the rules of the Moone, and of the tides, the declaration of the Sea-Chart, and other things appertaining hereunto.

Chap. I.
The definition of the Sphære.

A Sphære is a ſolide or maſſie body, without hollownes, & perfectly round; in the midſt whereof there is a pricke called the center, by which there paſſeth a right line named the axtree, and the points where this line endeth vpon the ſuperficies of the whole body are called poles, becauſe vpon them the Sphære is moued.

Chap. II.
That the whole world is a Sphære.

AND ſo it is euident that the whole frame of the world wherein we liue, is a Sphære; being as it is ſolide, ſo that in the whole world there is no emptie place: alſo it is perfectly round vpon the vpper ſuperficies of the higheſt heauen: and it hath in the very midſt a certeine point, to wit, the center of the earth, by which we doe imagine a right line or axtree, to paſſe from one pole to another, vpon which the world is moued about from eaſt to weſt.

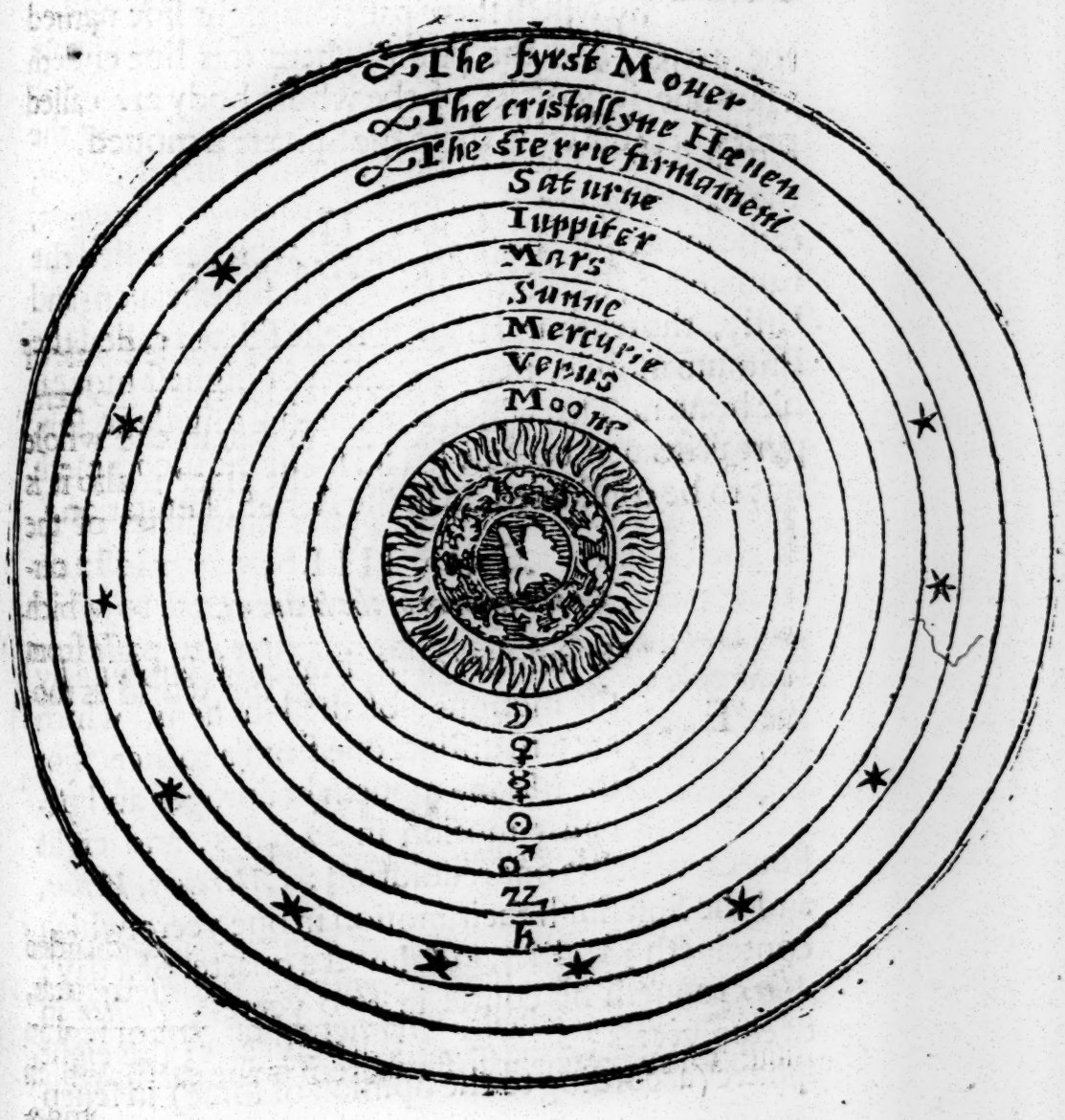
Chap. III.
Of the diuiſion of the Sphære.

THE whole Sphære of the world is diuided into two parts or regions; the elementar, and celeſtiall. The elementar part or region hath foure parts: the firſt whereof is the earth, which

tog-

together with the element of water (which is the second) maketh one perfect Globe:

A figure wherein may be seene the composition of the whole Sphære of the world.



and round about both theſe are two other elements, namely the aire, and aboue that the fire, which filleth the ſpace betweene the aire and the Sphære of the Moone: of which elements (by vertue of the heate of the heauens,) are made and compounded all corruptible things in the world.

The celeſtiall region conſiſteth of other ten parts: the firſt whereof is the ſphære of the Moone; the ſecond, the ſphære of *Mercury*; the third, of *Venus*; the fourth, is the ſphære of the Sunne; the fift, of *Mars*; the ſixt, of *Iupiter*; the ſeuenth, of *Saturne*; the eight, is the ſphære of the fixed ſtarres, which is called the firmament; the ninth is the Cryſtalline heauen; and laſtly, the tenth and higheſt is the ſphære called the Primum mobile, that is, the firſt or higheſt moueable heauen. That which remaineth, called the Empyreall heauen, becauſe it hath no motion, commeth not to be conſidered on in the Art of Nauigation.

Chap. IIII.

Of the motion of the heauens.

THe number of the heauens is knowne by the motions obſerued in them, which are ten, diſtinct one from another. For the Moone moueth her proper and peculiar motion in 27 daies, and eight houres, which is one reuolution: *Mercury*, *Venus*, and the Sun finiſh their motion in one yeere, which conteineth 365 daies, and almoſt a quarter of a day: *Mars* runneth his courſe in two yeeres; *Iupiter* in twelue yeeres; *Saturne* in thirtie yeeres; the eight ſphære (according to the opinion of ſome) in ſeuen thouſand

thouſand yeeres; the ninth, in fiue and twenty thouſand, & eight hundred yeeres; and the tenth, in foure and twenty houres almoſt. Which ten motions are reduced vnto three principall: the firſt is that of the firſt moueable vpon the two ends of the axeltree, which are called the poles of the world, from Eaſt to Weſt, turning about againe vnto the Eaſt in 24 houres: and this Sphære, by the force of his motiō, carieth about with it all the other lower Sphæres in the ſpace of 24 houres. Howbeit they moue alſo the contrary way with a ſecond motion, which is from weſt to eaſt, vpō two other poles diſtant frō the firſt, about three and twenty and one halfe, ſuch parts whereof the whole compaſſe of heauen conteineth three hundred and ſixtie. And this ſecond motion is accompliſhed in each of the lower heauens, in diuers ſpaces of time, as is before ſaid. The third motion is proper to the eighth heauen, wherein the fixed ſtarres are placed; which motion is the cauſe that the diſtance of the poles of the firſt motion, from them of the ſecond motion doth varie, being ſometimes greater, and ſometimes leſſe.

Chap. V.

Of the figure of the heauens.

THat the heauens are round, it is proued; becauſe roundneſſe is the moſt perfect figure of all others, being whole and entire, hauing no need of any ioints, being alſo of the greateſt capacitie of all figures that haue the ſame compaſſe, and in that reſpect moſt fit to conteine all other

things. Alſo the principall bodies of the world, as the Sunne, the Moone, and the ſtarres, are of this figure; and we ſee the ſame likewiſe in thoſe things which are bounded by themſelues; as it is manifeſt in drops of water, and all other liquid things.

Chap. VI.

That the earth and water make one perfect Globe.

THere is nothing that ſheweth more cleerely that the earth and water make one round Globe, then the ſhadow which they make in the eclipſes of the Moone: which ſhadow we alwaies ſee to be a part of a circle. For if the body, which is the cauſe of the ſame ſhadow, were three-ſquare, or foure-ſquare, the ſhadow it ſelfe alſo would appeare in the ſame faſhion. Wherefore the ſhadow of theſe two bodies together, being round, it is manifeſt that they are round alſo.

Chap. VII.

That the earth is in the center of the world.

ONe ſigne wee haue to be aſſured that the earth is in the midſt and center of the world; namely, that whereſoeuer we are vpon the face of the earth, we alwaies ſee one halfe of the heauens, the other halfe being hiddden out of our ſight. Moreouer, the ſtars (in what part of the heauens ſoeuer they be, either in the eaſt, weſt, or ſouth, we ſee that they are alwaies of the very ſame bignes. Wher-

by

by we may easily perceiue, that they are alwaies æqually distant from our sight: and whereas they moue round about it, it followeth that we are vpon the center of that body, on whose superficies the said starres describe their circles.

Chap. VIII.
The whole quantitie of the earth.

AND albeit the Globe of the earth and water, compared with the sphæres of the starres, is as it were a center or prick; yet being considered by it selfe, it conteineth in the greatest circle thereof 6300 common Spanish leagues. Which a man may easilie perceiue, by taking two such points or head-lands of the earth, as are vnder the same meridian, and which differ in distance one from another so much as one of those parts is, whereof the compasse of the whole world conteineth 360; and it is found both by nauigation at Sea, and also by trauell on land, that the two foresaid points are distant each from other 17 leagues and ½: of which leagues, each one conteineth 4000 pases, euery pase 5 foote, euery foote 16 fingers, and euery finger 4 graines of barley.

Chap. IX.
Of the Æquinoctiall circle.

BEing to treat of the circles of the sphære of the world, the first which offreth it selfe to be spokē of, is the æquinoctiall circle; by means whereof, we doe know in what part of the world we are:

and in it, in the Sea Chart are placed all theſe points or degrees of longitude; and from it the latitudes are accounted. So that the æquinoctiall is a circle which diuideth the world into two æquall portions, and is æqually diſtant euery where from either of the poles. And it is called the æquinoctiall circle, becauſe that when the Sunne paſſeth vnder it, vpon the 11 of March, and the 13 of September, it maketh the day æquall to the night. The knowledge of this circle in the Art of Nauigation, doth helpe vs to finde the latitude or diſtance from the line: and from this circle are reckoned the declinations of the Sunne in the regiment thereof. And alwaies thoſe Charts of Nauigation which are either vniuerſall, or halfe vniuerſall, haue this æquinoctiall circle, drawne with a great red line, which paſſeth by the beginning of the account of the degrees of latitude.

Chap. X.

Of the Poles of the world.

AND here it is to be noted, that one of thoſe two Poles, (from which the æquinoctiall is æqually diſtant) which is alwaies in our ſight, (becauſe it is continually aboue our Horizon) is called the pole arcticke, the ſeptentrionall, or north pole. But the other oppoſite pole (which we neuer ſee, becauſe it is vnder our Horizon) is called the pole antarcticke, and the meridionall, or ſouth pole. And ſo that part of the world which is betweene the æquinoctiall and the north pole, is called the North part

part: and that which is from the æquinoctiall to the south pole, is called the South part.

Chap. XI.
Of the Eclipticke line.

THe æquinoctiall circle is diuided into two æquall parts by another circle called the eclipticke, whereof one halfe is betweene the æquinoctiall and the north pole, and the other halfe betweene the æquinoctiall and the south pole. And that part thereof which is furthest distant from the æquinoctiall, is distant from the same about 23 degrees and a halfe. And because the Sun moueth in this circle without departing from it, hereof proceed the declinatiõs thereof. And this circle in all parts is æqually distant from the poles of the second motion, which are called the poles of the eclipticke. And through this circle the Sunne is continually moued by his proper motion from east to west: by means of which motion, sometimes he passeth vnder the æquinoctiall, and at other times departeth from it, both towards the north, and towards the south: and the quantitie of his greatest distance is about 23 degrees, and $\frac{1}{2}$: and so much is the distance of the poles of the eclipticke, from the poles of the æquinoctiall. And albeit this circle is not drawne in the Sea Chart, yet is it in some sort represented in the tables of the Sunnes declination, which are gathered from the motion, which the Sun maketh vnder the Eclipticke.

Chap.

Chap. XII.
Of the declination of the Sunne.

THe motion of the Sunne vnder the eclipticke, is the cauſe of his declination : which is nothing elſe but the daily ſwaruing or declining of the Sunne from the æquinoctiall line. And this declination when the Sunne is vnder the æquinoctial, vpon the one and twentieth of March, and three and twentieth of September, is nothing at all : ſo likewiſe vpon the two and twentieth of Iune, and two and twentieth of December, the declination is at the greateſt. And albeit this greateſt declination be now in our time about three and twenty degrees and an halfe ; yet hath it at other times been found otherwiſe, by reaſon of a third motion proper to the eighth heauen: but it alwaies keepeth betweene 23 degrees, 28 minutes ; and 23 degrees, 52 minutes. From hence therefore we doe infer, that at diuers times it is meet to make new and diuers tables of the declination of the Sunne.

Chap. XIII.
Of the Colures.

THere are two circles of the Sphære, either of which diuideth it into two æquall parts: and they are called Colures, becauſe that in the reuolution which they make, by force of the Pri-

Primum mobile, they doe not ſhew themſelues wholly vnto vs; ſo as wee may ſee all parts of them. One of them is called the Æquinoctiall colure, becauſe it paſſeth by the poles of the world, and the points where the eclipticke cutteth the æquinoctiall; and when the Sunne by his owne proper motion commeth vnto it, hee maketh the day and the night æquall, and diuideth the winter from the Spring by the one part; and by the other, ſummer from Autumne; at which times the Sunne hath no declination at all. The other is called the Solſtitiall colure, becauſe it paſſeth by the poles of the world and of the ecliptick, and by the points where the eclipticke is furtheſt diſtant from the æquinoctiall. And when the Sunne by his proper motion commeth vnto it, in the one part it maketh the longeſt day, and the ſhorteſt night, and diuideth the Spring from the Summer, and hath his greateſt declination towards the north: and being in the other part, the Sunne maketh the longeſt night, and ſhorteſt day, and diuideth winter from Autumne, and is in his greateſt ſoutherly declination. Theſe two colures are noted in the table of the Suns declination: becauſe the æquinoctiall colure paſſeth by the two points where there is no declination at all, becauſe the Sun is vnder the very æquinoctiall circle: and the ſolſtitiall colure paſſeth by that place where the Sun hath his greateſt declination, which is in 23 degrees and an halfe, or thereabouts.

CHAP.

Chap. XIV.
Of the Meridian circle.

THe Meridian is a circle drawne by the poles of the world (which are all one with the poles of the æquinoctiall) and by the point directly ouer our heads, called the Zenith. And it is called the Meridian, becauſe that when the Sunne by the motion of the Primum mobile commeth vnto this circle, it maketh mid-day, and then he hath been running his courſe from his riſing, till he come thither; iuſt ſo long time as he ſhall be running from thence to the place of his ſetting. The Zenith is a point in the firmament placed directly ouer our heads. And it is to be noted, that when the Sunne is in that circle, it hath the greateſt altitude aboue our Horizon, that it can poſſibly haue the ſame day: by this, and the declination, we come to know how farre we are diſtant from the æquinoctiall, either towards the north, or towards the ſouth. And hence it is that the height of the Sunne in Nauigation is vnderſtood only for that height which the Sunne hath when he is in this circle. And ſo the height of the Sunne ſhall be that part of the meridian which is conteined betweene the Sunne and our Horizon. This circle in the Sea Chart is repreſented by all thoſe lines which are drawne from north to ſouth.

Chap. XIV.
Of the Horizon.

THe Horizon is a circle which diuideth that part of the heauens which we ſee, from the reſidue which we do not ſee: and it is properly that circle by which, according to our ſight, the heauen ſeemeth to be ioined with the water, when we are at Sea, without ſight of any land. This Horizon is of two ſorts, namely, right, and oblique. The right Horizon is that which they haue that liue vnder the æquinoctiall, which paſſeth by their Zenith; and therefore the æquinoctiall line or circle falleth perpendicularly and right acroſſe with their Horizon, and both the ſouth and the north poles are in their Horizon. The oblique Horizon is that which they haue that liue not directly vnder the æquinoctiall; for vnto them the æquinoctiall diuideth the Horizon obliquely, and not right acroſſe: and one pole is alwaies aboue their Horizon, and the other is beneath their Horizon, and cannot be ſeene. This Horizon is repreſented in the Sea-Chart by a certaine imagined circle, whoſe center is the point where our ſhip is. From which center are imagined to proceed vnto the ſaid circle 32 lines, which repreſent the 32 windes or rumbs; which alwaies are drawne in our Sea-Compaſſe: which likewiſe in a little peece of paper doth continually repreſent vnto vs both by day and by night, the whole Horizon with his 32 diuiſions.

Chap. XVI.
Of the 32 windes.

THis right or oblique Horizon is diuided into 32 æquall parts, by 16 lines, which they call Rumbs: and they cut themselues in the point where wee stand: of which rumbs, that which passeth by the points where the æquinoctiall beginneth and endeth (which are where the Sunne riseth, and setteth the 11 of March, and the 13 of September) is called east and west; and that which cutteth it right acrosse, is named north and south. And the foure extreames or ends of these two lines, are distant vpon the Horizon one fourth part of a circle, and they make foure quarters. Euery one of which quarters being diuided in the midst, doe make foure other points: and that which falleth betweene the north and the east, is called north-east; and that betweene the north and the west, north-west; that betweene the south and the east, south-east; and that betweene the south and the west, south-west. And so the Horizon is diuided by foure lines or rumbs, into eight principall windes, noted in the Sea-Chart with blacke lines. And if you diuide euery one of those eight parts in the midst, you shall haue other eight lines, and other foure rumbs, which in all are sixteen windes. And each one of these hath his name compounded of the names of those principall winds which are on either side therof. As for example, that halfe winde which is betweene the north and the north-

north-east, is called north north-east, and that which bloweth betweene the east and the north-east, is called east north-east; and that betweene the east and the south-east, east south-east; and that betweene the south and the south-east, south south-east; and that betweene the south-west and the west, west south-west; and that betweene the west and north-west, west north west; and that betweene the north-west and the north, north north-west. And these are noted in the Chart with greene lines.

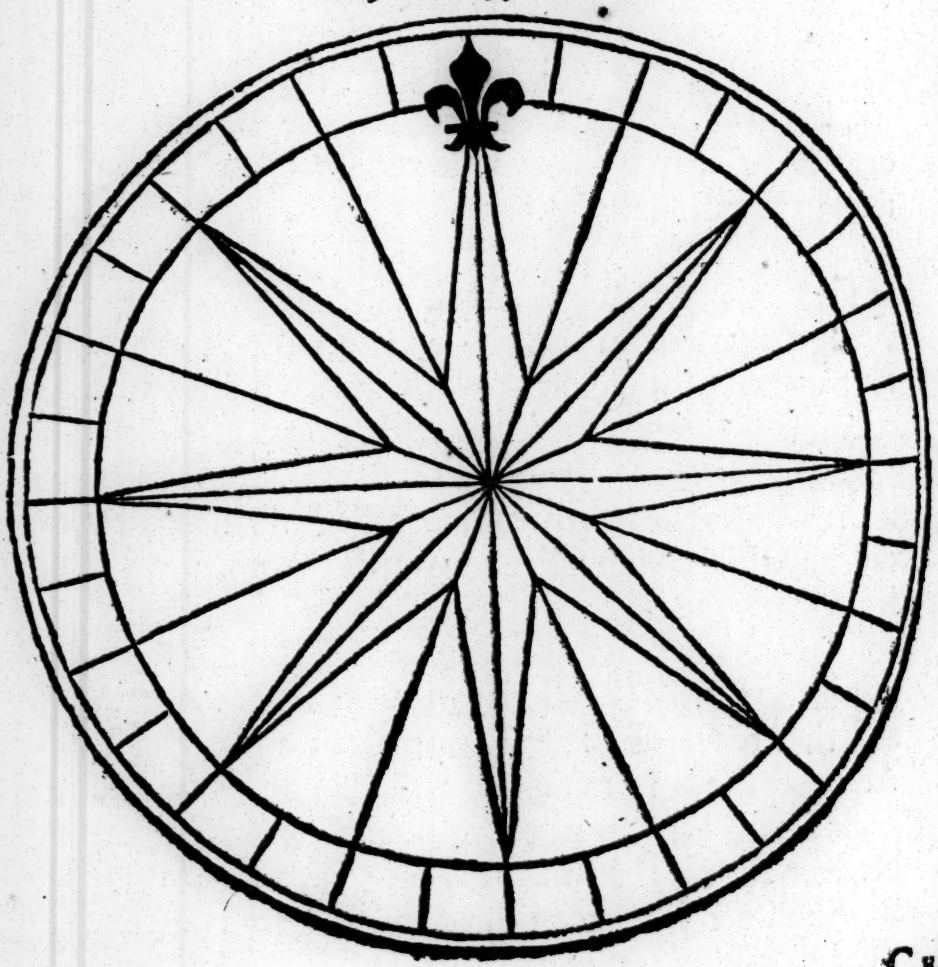
Finally, if you diuide euery one of these sixteene windes in the midst, they will yeeld you other sixteene windes, and will amount to two and thirty windes in all. Which sixteene last mentioned, are drawne in the Sea-Chart with red lines, and are by the Spaniards called quarters of the eight first and principall windes: and euery one of these is called by the name of that principall winde which is next it, together with an addition of the word (by) and the name of another principall winde which is next vnto it. As for example, of the two quarter windes which fall next the rumbe of the north, that which lieth towards the north-east, is called north and by east; and that which falleth towards the north-west, is called north and by west. So likewise of those two windes which blow next the north-east, that towards the north, is called north-east and by north; and that towards the east, north-east and by east. And after the same maner you may name all the rest.

But here is to be noted that there is difference between the rumbe and the winde, because a rumbe is one direct line continued with two contrarie windes, as the rumbe of north and south, and the rumbe

Difference betweene the Rumbe and the winde.

rumbe of eaſt and weſt. And ſo when we will name the lying of any coaſt, we will ſay that it lieth north and ſouth, or north and by eaſt, and ſouth and by weſt. But the winde is one line of thoſe 32, into which the Horizon is diuided; and it is one part of thoſe two which together are called the rumb. And ſo we ſay, that land lieth from vs towards the ſouth, or towards the South and by weſt, or towards the ſouth ſouth-weſt,&c.

The figure of the Sea Compaſſe, and of the Horizon; diuided into 32 windes, by 16 rumbes.



Chap. XVII.
Of the two Tropickes.

BEsides the six circles aboue mentioned, which are drawne vpon the superficies of the Sphære of the world, there are other two which the Sunne describeth with the motion of the Primum mobile, about the twelfth day of Iune and of December: of which two circles, that which the Sunne describeth the twelfth of Iune, from the time of his rising, til the time that he riseth the day following, is called the tropicke of the summer sun-standing; or the tropicke of *Cancer*: for the Sun hauing departed from the æquinoctiall, and increasing his declination towards the north, when he commeth to describe that circle, for two or three daies it seemeth that he commeth no neerer to our Zenith, nor departeth from the æquinoctial one day more then another: but frō thence forwards he goeth backe, diminishing his declination till he come to the æquinoctiall; and crossing the same, he goeth on the other side, increasing his declination vntill the twelfth of December, vpon which day, from the time of his rising, till hee be come about to rise againe the next morning, he describeth another circle called the tropicke of the winter Sun-standing, or the tropicke of *Capricorne*; for the Sunne being departed from the æquinoctiall, and increasing his declination towards the south, when he commeth to describe that circle, it seemeth for two or three daies, that he returneth not one

whit towards the æquinoctiall, nor goeth further from our Zenith one day more then other; but from thence forwards he commeth backe againe, diminiſhing his declination, till he be returned to the æquinoctiall, and from thence towards our Zenith. Theſe two circles in Sea-Charts are marked with two great red lines drawne from Eaſt to Weſt, which lie on either ſide of the æquinoctiall, being diſtant from thence about 23 degrees and ½. And whereſoeuer our ſhip be in any place betweene theſe two circles or lines, we may in ſome time of the yeere take the Sunne in our Zenith, at which time it maketh no ſhadow at all, being then iuſt 90 degrees high aboue our horizon. But they which are without the ſaid two circles or lines, ſhall neuer haue the Sun in their Zenith, becauſe it cannot come to the height of 90 degrees aboue their horizon.

Chap. XVIII.
Of the Parallels.

THe parallel circles are thoſe which are in all parts æqually diſtant from the æquinoctiall. And theſe circles may be infinite betweene the æquinoctiall, and the north and ſouth poles; and in the Sea-Chart ſome of them are repreſented by the lines which are drawne from eaſt to weſt. And two of theſe circles are the two tropicks of *Cancer* and *Capricorne*, which are the bounds of the Sunnes greateſt declinations. Likewiſe all thoſe circles which the Sunne and the ſtarres in heauen doe by the motion

tion of the firſt or higheſt moueable heauen deſcribe from Eaſt to Weſt, are parallels, and ſerue in the ſphære to ſhew the latitude. And when a ſhip ſaileth in the ſame height of the pole, then ſhe ſaileth in a parallel, and runneth alwaies Eaſt or Weſt. Which manner of ſailing we vſe, at all ſuch times, when wee finde our ſhip in the height of that land to which we are going.

Chap. XIX.
Of the Degrees.

EVery one of theſe circles is diuided into 360 æquall parts, which they call degrees; and euery degree is diuided into other 60 æquall parts, which are called minutes: which degrees and minutes, are the common meaſure that wee vſe in nauigation, when wee make any account in the heauens, either in taking the height of the Sunne and ſtarres aboue the Horizon, or in meaſuring the diſtance from our zenith to the æquinoctial. Theſe degrees are marked in a line drawne from North to South in the moſt vacant part of the Sea-chart. This line in generall Sea-charts is diuided into 90 æquall parts, which are counted (beginning at the æquinoctiall line) from one to 90, both Northwards and Southwards. And in thoſe Charts which are not general, this line hath ſuch diuiſions as it is capable of, according to the largeneſſe of the Chart, beginning to make account from the æquinoctial.

Chap. XX.

What is meant by longitude and latitude.

THe longitude of any place is a part of the æquinoctiall, or of ſome other parallel contained betweene two meridians: whereof one paſſeth by the Canarie Ilands, and the other by the place giuen; but if neither of ỹ ſaid meridians paſſe by the foreſaid Ilands, it is called reſpectiue longitude. And this reſpectiue longitude is called in the art of Nauigation the diſtance or length of the right line, which is determined or bounded by two other right lines running North and South; of which two, the one paſſeth by the port or hauen from whence wee ſet ſaile, and the other by the place where our ſhip is. And ſo ſhal the diſtance of the right line, be one part of any right line whatſoeuer running Eaſt and Weſt, comprehended betweene the two foreſaid right lines extended North and South.

The latitude of a place is a part of any meridian whatſoeuer contained between two parallels, whereof one is the æquinoctiall, and the other the parallel of the place giuen. This latitude the mariners doe call the diſtance from the line: vnderſtanding by the line the moſt principall of all others which are drawne in the Chart, that is, the æquinoctiall line. They vſe alſo to call it the heigth, which is as much to ſay, as the heigth of the pole aboue the Horizon. And ſo the diſtance from the æquinoctiall ſhall be a part of any North and South line contained betweene

The æquinoctial is called the line, becauſe it is the principall of all others which are drawne in the Chart.

tweene the æquinoctiall, and any line running from East to West, which passeth in the graduation of the Chart, by the same degree of latitude in which we finde our selues to be.

The second part of the Art of Na-

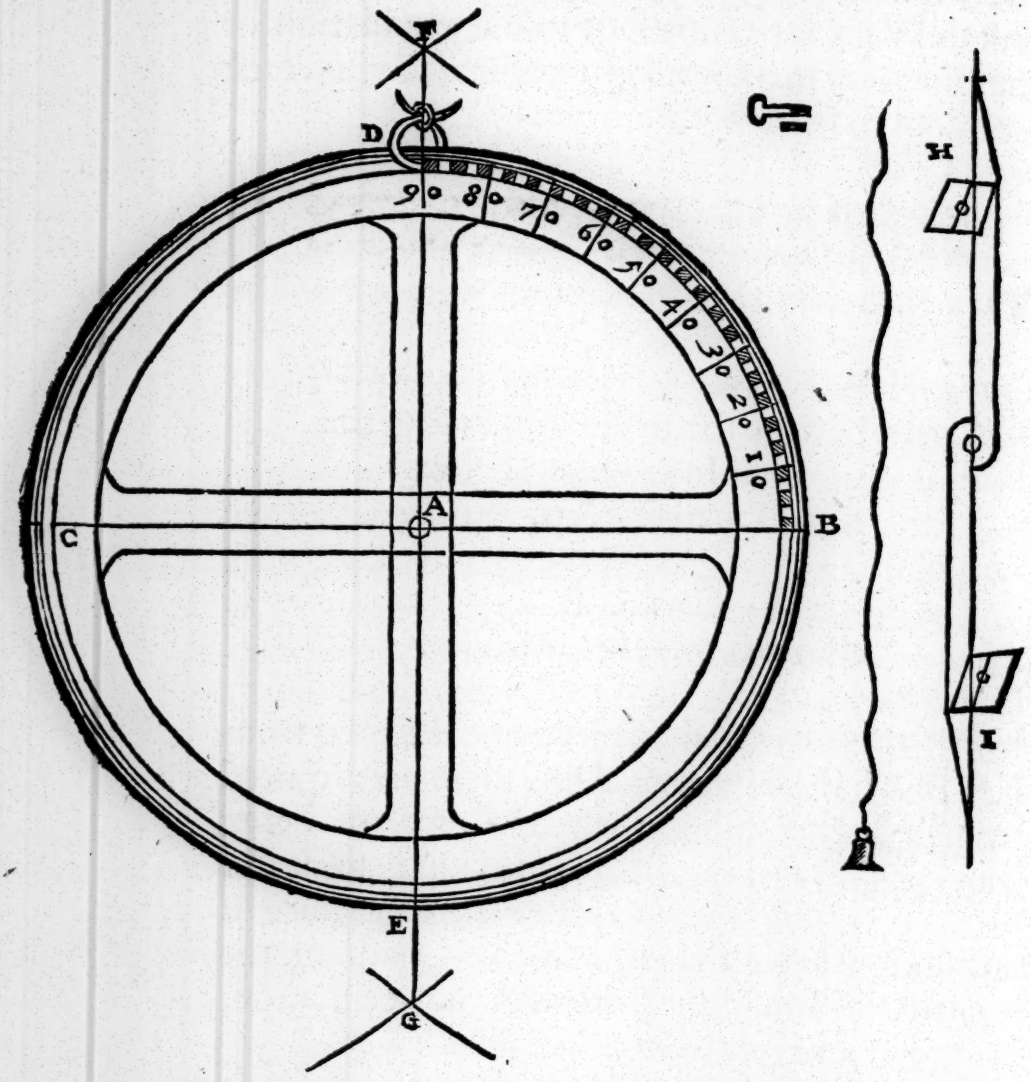
uigation, wherein is handled the practick part, shewing the making and vse of the principall Instruments belonging to this Art.

Chap. I.

The making of the Astrolabe.

TO know the latitude or distance from the æquinoctial line there are required fiue things: whereof any one being wanting, we cannot possibly finde out how farre wee are distant from the said line. And these are, the Astrolabe or Quadrant, the height of the Sunne, the shadowes, the declination, the regiment or rules of the Sunne.

The Astrolabe is to be made after this manner: In the midst of a round plate or table of metall or wood being smooth and plaine euery where and about a finger thicke, you shall take the center A, wherein hauing placed one foote of your compasses, you shall with the other draw as great a circle as conueniently you can in the said table. And within



this circle must be drawne two other circles, the one distant from the other about the breadth of a graine of wheate, and the third must be distant from the second twice so much as the second is from the first.

And your ruler being laid iust to the center A, you

you ſhall draw the line B, A, C, which diuideth euery one of the three circles into two equal parts. And putting one point of your compaſſe (ſtanding open according to the length of the line B C) vpon the point C, where the greateſt circle is diuided by the line B C; with the other point, you ſhall draw aboue the point D a part of a circle, and another vnder E. And then putting one foote of the compaſſes thus opened vpon the point B, you ſhall draw other two parts of a circle which will croſſe the firſt in F and G. And your ruler being laid to F and G, you ſhall draw the line D E which muſt paſſe by the center A. Then let the quadrant D B be diuided into three equal parts: and euery one of thoſe into three other parts, and each of thoſe 9 into two, and euery one of thoſe 18 into 5; and ſo the ſaid quadrant ſhall be diuided into 90 equal parts or degrees. Vnto which degrees ſhall be placed the numbers belonging to them from 5 to 5, between the ſecond and the third circle beginning from B, and ending with 90 at the point D. Then let there be made at the point D a little hole vpon the line D E, through which may be put a little ring, or ſome ſtrong ribband, or ſtring: and you ſhall make a knot thereon, whereby your finger may take hold: and the Aſtrolabe hanging by that hole, you ſhall put through a ſlender threed with a plummet of lead, which may hang quite vnder the Aſtrolabe; which threed, if (while the Aſtrolabe hangeth immoueable) it fall iuſt vpon the line D E, then is the Aſtrolabe well rectified: If not, you muſt continue cutting off ſome thing, & lightning that ſide towards which the threed doth fall,

vntill it hang euen with the foreſaid line. Then muſt you draw vpon a ruler of the ſame matter, (being about a finger and an halfe broad) the right line H I along through the very midſt of the breadth thereof: which ruler ſhall be made after the ſame faſhion that here is ſet downe, cutting away from one halfe of the length, halfe of the breadth, alwaies ſauing whole the line H I. And ſo likewiſe ſhall you cut off along the halfe of the length on the contrary part, halfe of the breadth; ſo that the line H I may remaine whole on that ſide alſo. And neere to the ends of the ſaid ruler, you ſhall ſet two little ſquare fanes of the breadth of the ruler in the midſt, ſtanding vpright, the very midſt of both fanes being placed vpon the line H I. Through the centers of which two fanes ſhall be made two little holes, both which muſt ſtand directly ouer the line H I, and in equall diſtance from the vpper face of the ruler. This ruler by a hole bored thorow the midſt thereof, ſhall be faſtned vpon the ſaid Aſtrolabe through another hole of the bigneſſe of that in the ruler, at the very center A with a naile, which may be made faſt with a little pin, as is to be ſeene in the figure.

Chap. II.

Of the heigth of the Sunne.

TO take the heigth of the Sunne, you muſt hold the Aſtrolabe by the ring or knot D, in your left hand: and turning your right ſide to the Sunne, lift vp the ruler with your right hand, till the beame of the Sun entring by the hole of

of the vppermoſt vane, doth alſo pearce thorow the hole of the nethermoſt vane: And then note the degree, and part of the degree which the line H I doth touch; for that is the heigth of the Sun aboue the Horizon; which if it be the greateſt heigth that the Sun hath that day, it will teach vs how farre we are diſtant from the æquinoctiall. This greateſt heigth is to be taken at midday, lifting vp the vppermoſt vane, till wee be aſſured that the Sun ceaſeth to riſe any higher, but beginneth to fall againe. Then note that greateſt heigth, and keepe it for the making of your account of the latitude by the Sunne.

Chap. III.

Of the ſhadowes.

THE ſhadowes being compared with the Sun, may be of three ſorts: for at high noone the ſhadow falleth either towards that part of ỹ world to which the Sunne declineth, or towards the contrary part, or elſe we make no ſhadow at all. The firſt and ſecond ſort are, when the heigth of the Sun is leſſe then 90 degrees, and the third is when it is iuſt 90 degrees high. The firſt is when the Sun keepeth his courſe on the North ſide of the æquinoctial, which is from the 11 of March to the 13 of September; and likewiſe when the ſhadowes fall towards the North of the Compaſſe: or when the Sunne runneth on the South ſide of the æquinoctial, (which is from the 14 of September to the 10 of March) and the ſhadowes likewiſe fall towards the

the ſouth of the Compaſſe: and this is when the Sun and the ſhadowes goe both one way. The ſecond is, when the Sunne comming towards the North, the ſhadowes are caſt towards the South of the Compaſſe; or when the Sunne is on the South ſide of the æquinoctial the ſhadowes fall towards the North: and this is, when the Sun and the ſhadowes are differing.

The rule of the ſhadowes is, that wee looke well to the lower fane of the Aſtrolabe when wee are taking the height of the Sun at noone: For if the line H I fall directly vpon the line of the Aſtrolabe D E, then we haue no ſhadow, becauſe the Sun is in our zenith 90 degrees high. But if the line H I fall not vpon the line D E, you muſt marke towards what part of the world the lower part of the ruler doth decline frō the point E; which if it decline towards the North of the Compaſſe, then the ſhadowes fall Northwards. But if it decline towards the South of the Compaſſe, then the ſhadowes fall Southwards.

Chap. IIII.

Of the regiment and rules of the Sunne.

When you know the part, or parts of the Sunne and ſhadowes, and deſire by the Sunne to know how farre you are diſtant from the æquinoctiall, you haue fiue rules: The firſt whereof ſheweth in what part of the heauens the Sunne is, that is, whether he be North or South from the æquinoctiall at the time of your obſeruation. The ſecond teacheth

teacheth what account we are to take of the Sunne, when he caſteth no ſhadow, becauſe he is in our zenith, and is found in the Aſtrolabe to be iuſt 90 degrees high. The third is, of the account to be made by the Sun, when taking the heigth thereof in leſſe then 90 degrees, it maketh a ſhadow at high noone, and hath no declination becauſe it is vnder the æquinoctiall. The fourth is, of the account that is to be made, when the Sun and the ſhadowes are both one way from the line. The fifth is, when the Sunne and the ſhadowes are different, one being towards the North, and the other towards the South.

The firſt rule of the Sunne.

From the 11 of March, to the 13 of September, the Sunne runneth on the North ſide of the æquinoctiall. And from the 14 of September to the 10 of March he goeth on the South ſide thereof.

The ſecond rule of the Sunne.

When wee obſerue the Sunne in 90 degrees of heigth, we muſt ſee what degrees and minutes of declination the Sun hath the ſame day: And then we may ſay, that wee are ſo much diſtant from the equinoctial towards that part of the world to which the Sunne declineth.

The third rule of the Sunne.

When the Sunne is leſſe then 90 degrees high, if there be no declinatiõ the ſame day, then ſo much as it wanteth in heigth of 90 degrees, ſo much are we diſtant from the æquinoctiall, towards that part of the world towards which the ſhadow falleth.

The fourth rule of the Sunne.

When the Sunne and the ſhadowes are both towards

wards the ſame part of the world, we muſt note how much the Sunne wanteth of 90 degrees in height. And that which it wanteth (being added to the declination of the Sunne the ſame day) is our iuſt diſtance from the æquinoctiall towards that part of the world to which the Sunne and ſhadowes decline.

The fifth rule of the Sunne.

When the declination of the Sunne, and the ſhadowes be different, we muſt adde the heigth of the Sunne vnto the declination which it hath the ſame day: And if the Sun amount to 90 degrees iuſt, then are we vnder the æquinoctiall line: but if it exceed 90 degrees, wee are ſo much diſtant from the æquinoctiall towards that part of the world wherein the Sunne is, as that exceſſe or ouerplus commeth to. And if the heigth and declination added together come to leſſe then 90, looke how many degrees and minutes you want of 90, ſo many are you diſtant from the æquinoctiall towards that part to which the ſhadowes fall.

And here is to be noted that wee muſt likewiſe make account of the minutes, becauſe they may be both in declination, and in heigth, and ſo alwaies in that declination where wee ſhall finde 60 minutes, we muſt make of them one degree. And if in taking the heigth wee finde halfe a degree beſides all the whole degrees, it is as much as 30 minutes, and one third part of a degree is 20 minutes, one fourth 15 minutes, one fifth part 12 minutes, and one ſixth part 10 minutes.

Chap. V.

Of the declination of the Sunne, and of his tables.

THat wee may know what vſe to make of the fiue foreſaid rules of the declination of the Sun, we are to note, that the yeere (which is the time of the Sunnes motion from any point of the ecliptick till hee returne againe to the ſame point) conſiſteth not alwaies of an equall number of daies. For beſides 365 daies it containeth almoſt one quarter of a day: but the yeere which we commonly account containeth 365 daies in common yeeres, and in leape yeers 366. It was therefore needfull to make foure tables of twelue moneths apeece (whereof the three firſt containe 365 daies, and the fourth 366) and in ſuch ſort to diſtribute the declination of the Sun among them, that you may make account of the declination which is wanting to the Sun at the end of 365 daies, for lack of thoſe ſixe houres almoſt which the Sun wanteth to come vnto the point, from which it departed at the beginning of the yeere: and alſo of the declination which reſulteth in the fourth yeere, becauſe it conſiſteth of 366 daies, at what time it commeth to recouer that which in the three former yeeres it had loſt. Therfore to know at al times which of the foure tables we ought to make vſe of, I will ſet down a rule whereby you may know whether the preſent yeere be leape yeere, or whether it be the firſt, ſecond or third yeere after the leape yeere.

And

And the rule is this, that taking from the yeeres of our Lord (which run in our common account) the number of 1600, if the remainder thereof be an euen number, and halfe of the remainder an euen number, then that yeere is leape yeere: and if the remainder be euen, and the halfe thereof odde, then that yeere is the ſecond yeere after the leape yeere. But if the remainder of the yeeres number be odde, we muſt trie the yeer next going before, to ſee whether the remainder thereof, and halfe the remainder be euen numbers, for then the preſent yeere is the firſt after the leape yeare. And if the remainder of the yeere going before be euen, and the half thereof odde, then the preſent yeere is the third yeere after the leape yeere.

How the declination of the Sun may be found out.

Now to know the Suns declination euery day, we muſt looke in that table which anſwereth to the preſent yeere, and ſeeking the moneth in the vpper part of the page, and the day of the moneth wherein we would know the declination, in the columne which deſcendeth towards the left hand; right ouer againſt the ſaid day, and vnder the title of our moneth, wee ſhall finde two numbers; one of degrees, and the other of minutes; which are the declination of the Sunne that day, toward that part of the world which the firſt rule of the Sunne doth teach.

Chap. VI.

The æquation of the Sunnes declination.

THey which saile in the moneth of Iune and December neede not much to make any æquation, in the table of the Sunnes declination, because that in those moneths the declination of one day differeth very little from the declination of another. But at all other times of the yeere we ought to make some kinde of æquation to know precisely our heigth, or our distance from the æquinoctiall. This æquation is to be made after this manner: You must subtract the declination of the Sunne for the present day from the declination of the day following, or contrariwise (subtracting alwaies the lesse out of the greater) and the difference, or remainder shal be multiplied by the leagues which our ship hath sailed from the meridian of *London*; and the product of the multiplicatiõ must be diuided by *7200 leagues, which are contained in the compasse of the whole earth: then (if you haue sailed westward) the quotient must be added to the declination of the Sunne that day, if it be from the 11 of March to the 12 of Iune; or from the 13 of September to the 12 of December: or it must (if the shippe also hath sailed Westward) be subtracted if you finde it in any other time of the yeere, except in the daies of the æquinoctium: for then this difference is known by taking the declination of the present day with that of the day following: but if you be to the Eastward

*These leagues must be counted in the æquinoctial betweene the meridians of the two places. But it were better to finde the differẽce of longitude: for thẽ as 360 degrees are to that difference; so is the difference of declination to the æquation desired.

ward from the meridian of *London*, you muſt doe contrariwiſe, ſubtracting the ſaid æquation where before you added it.

In ſtead of the table of the Sunnes declination here inſerted by Roderigo Samorano, *vſe the table before ſet downe from the 399 page, to the 423 page.*

Chap. VII.

Foure examples for the plainer declaration of that which is ſaid before.

An example of the ſecond rule.

IN the yeere 1608 the 15 of April, ſuppoſe I was ſailing, and tooke the heigth of the Sunne with my Aſtrolabe at noone, and found the heigth thereof to be iuſt 90 degrees. Firſt therefore I tooke from 1608 the number of 1600, and there remaine 8, which remainder being an euen number, and foure the halfe thereof being euen alſo, I ſay the yeere 1608 is the leape yeere. And ſo I goe vnto the fourth yeere in the table of the Sunnes declination, which is leape yeere, and vnder the moneth of April, ouer againſt the 15 day, I finde 13 degrees and 25 minutes, 41 ſeconds: I ſay therefore that I am diſtant from the æquinoctial towards the North 13 degrees and 26 minutes almoſt, becauſe it is betweene the 11 of March and the 13 of September, in which ſpace falleth the 15 day of April.

The ſecond example of the third rule.

In the yeere 1602 vpon the 13 day of September, admit I tooke the heigth of the Sunne, and found it in my Aſtrolabe to be 70 degrees and an halfe: and

that

that in the table of declination belonging to the ſame yeere, vpon the foreſaid day of September, I found that the Sun had no declination, but that it was vnder the very æquinoctiall line. Now becauſe the degrees of the heigth which the Sun wanteth of 90 are 19 and an halfe, I ſay that I am ſo much diſtant from the æquinoctiall toward that part of the world vnto which the ſhadow falleth.

Example of the fourth rule.

Vpon the 13 of May 1609, ſuppoſe I tooke the heigth of ☉ Sun at noone in my Aſtrolabe, & found it to be 85 degrees and three quarters. Now becauſe 1609 is an odde number, I goe back to the former yeere of 1608, and I finde (according to the rule of leape yeeres) that the yeere 1608 is leape yeere, and hence I iudge that the yeere 1609 is the yeere next following the leape yeere.

Then I goe to the tables of declination belonging to the firſt yeere after the leape yeere, and vnder the moneth of May againſt the 13 day, the Suns declination is found to be 20 degrees, 41 minutes, 15 ſeconds: and becauſe that from the 11 of March to the 13 of September the Sun keepeth his courſe to the Northwards of the æquinoctial, hauing marked the ſhadow at midday, I ſee that the lower vane of mine Aſtrolabe, looketh to the North of the Compaſſe, and ſo I ſay that the Sun and the ſhadow are both one way. Then I looke for the heigth which is 85 degrees, and three quarters, ſo that it lacketh of 90 degrees foure degrees and one quarter, which is fifteene minutes. Theſe foure degrees and fifteene minutes being added to the declination, which is

twentie degrees and 41 minutes, amount in all to 24 degrees and 56 minutes: And ſo much am I diſtant from the æquinoctiall towards the North, which is the part of the Sun and of the ſhadowes.

An example of the fifth rule.

Vpon the 17 of October 1609 (which is the firſt yeere after the leape yeere) the Sun now going his courſe towards the South, ſuppoſe I tooke his altitude in 50 degrees and one third. And when I tooke it, the lower vane of mine Aſtrolabe declined toward the North of my Compaſſe: wherefore I ſay that the Sun and the ſhadowes are different. And ſo adding 50 degrees and 20 minutes (which is one third part of a degree) with 12 degrees and 55 minutes (which vpon that day is the Suns declination) they amount in all to 63 degrees and 15 minutes: which are leſſe then 90 degrees by 26 degrees and 45 minutes: and ſo farre am I diſtant from the æquinoctiall to the part of the ſhadowes, that, is to the North: for the Sun and ſhadowes being different, the heigth and declination came not to 90 degr.

A ſecond example of the fifth rule.

The ſame day and yeere ſuppoſe that ſome man found the Sunne in 77 degrees and fiue minutes of heigth, the Sun it ſelfe declining to the South, and the ſhadowes falling to the North; which being added to 12 degrees and 55 minutes of declination, amounteth in all to 90 degrees, iuſt: whereby I know that the ſhip wherein this altitude is taken, is vnder the æquinoctial: becauſe the Sunne and ſhadowes

dowes being different, the heigth and declination make iuſt 90 degrees.

The third example of the fifth rule.

Vpon the 20 of May 1608, ſuppoſe a certain man found the Sunnes heigth to be 88 degrees and two third parts, the Sun and ſhadowes being different: which being added to 21 degr. 54 minutes, (the Suns declination that day) amounteth to 110 degrees 34 minutes, which exceed 90 by 20 degrees and 34 minutes. I ſay therefore that this man is 20 degrees and 34 minutes diſtant from the æquinoctial, towards the part of the Sun, which is to the North, becauſe the Sunne and the ſhadowes being different, the heigth of the Sun, and the declination being added together exceed 90 degrees.

Chap. VIII.

Another manner of accounting by the Sunne, as they vſe in Portugall.

SOme Aſtrolabes there bee, whoſe account beginneth not from the horizon but from the zenith, and endeth with 90 degr. in the horizon; and the heigth taken by them is nothing elſe but the diſtance of the Sun from our zenith: And to make an account of the Sunne, according to the altitude taken with ſuch Aſtrolabes, there are theſe rules following to be obſerued.

1. When the Sunne and the ſhadowes are both one way, adde the heigth vnto the declination, and

the product will ſhew how farre you are diſtant from the line, towards the part of the Sun and ſhadowes.

2. If the Sunne and the ſhadow be differing, ſubduct the declination from the heigth, or the heigth from the declination (the leſſer from the greater) and the remainder will ſhew how farre you are from the line, towards the part of that which is greater: and if the heigth be greater, then are you on the part of the ſhadowes.

3. When the Sun is in the line and hath no declination, ſo much altitude as you ſhall find, ſo farre are you diſtant from the æquinoctiall towards the part of the ſhadowes.

4. When you ſhall take the Sunne in your Zenith, hauing then no altitude, his declination will ſhew you how farre you are diſtant from the line towards the part of the Sun.

Theſe rules, becauſe they are ſo eaſie and plaine, need no examples.

Chap. IX.

How the heigth of the Sun may be knowne in any place whatſoeuer without an Aſtrolabe; firſt knowing your diſtance from the æquinoctial.

SOme Pilots for their curioſities ſake deſire to know the heigth of the Sun for any day without an Aſtrolabe. For the performance whereof, it is expedient that they know three things: that is to ſay, the declination of the Sun, the diſtance of the place from

the æquinoctiall, and the part whereunto the ſhadowes doe incline at midday. Theſe three being knowne, you ſhall come to the knowledge of the Sunnes heigth by foure rules.

1. When you and the Sun be both on one ſide of the æquinoctiall, if your diſtance from the line be equall to the Suns declination, you ſhall finde the Sun in your zenith in 90 degrees, and ſhall haue no ſhadow.

2. When the Sun hath no declination, look how much your diſtance from the æquinoctiall wanteth of 90 degrees, for ſo much is the heigth of the Sunne.

3. When the Sunne and the ſhadowes are both towards one part, ſubtract out of your diſtance from the æquinoctiall the declination of the Sunne that day, and that which the remainder ſhall want of 90 degrees, ſhall be the heigth of the Sun.

4. When the Sunne and the ſhadowes are different, if the æquinoctiall be betweene you and the Sunne, adde the declination of the Sunne to your diſtance from the æquinoctial, and that which theſe two numbers added together ſhall want of 90 degrees, ſhall be the heigth of the Sunne. But if you be betweene the Sunne and the line, you muſt ſubduct your diſtance from the line out of the Sunnes declination, and then that which the remainder ſhall want of 90 degrees, ſhall be the heigth of the Sunne.

Chap. X.

The rule, or regiment of the North ſtarre, for the knowledge of the heigth of the Pole.

THe zenith is the pole of the Horizon, becauſe it is euery where diſtant from it iuſt 90 degrees. And hence it is that the pole of the world is ſo much eleuated aboue our Horizon, as our zenith is diſtant from the æquinoctiall, which is very manifeſt: for hauing 90 degrees of the meridian from our zenith by the pole of the world to the horizon; and other 90 degrees of the meridian from the pole of the world, by our zenith to the æquinoctial; becauſe they are two quadrants of one and the ſame circle, they muſt needs be of equall quantitie: from both which that part being taken away which is common to both (that is, the whole diſtance from the pole of the world to our zenith) that which remaineth on both parts ſhall be equall. And ſo that ſpace from our zenith to the æquinoctial (which is called the diſtance from the line) is equall to the diſtance that is betweene the pole of the world and the horizon, which is called the heigth of the pole.

Whereby it is manifeſt that the heigth of the pole is ſo much as our diſtance from the line is. And although they are two different things, yet the one is taken for the other becauſe they are equall.

This heigth of the pole is knowne by the help of foure

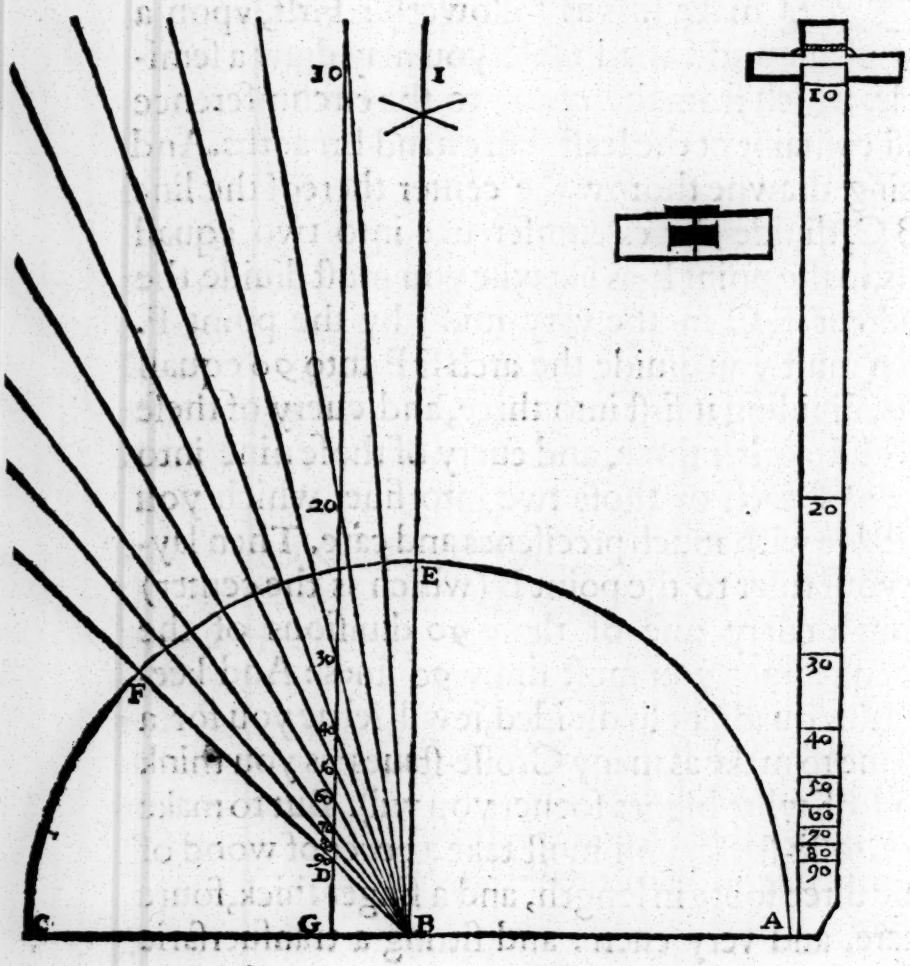
foure things, which are the Balleſtilla or Croſſe-ſtaffe, the poſition of the North ſtarre, the heigth of the ſaid ſtarre, and certaine rules.

Chap. XI.

The making of the Croſſe-ſtaffe.

THe mariners Croſſe-ſtaffe is that which by the Aſtronomers is called *Radius aſtronomicus*: and the manner how to make it is as followeth: Firſt, vpon a very plaine and broad table you may draw a ſemicircle, which from the center to the circumference muſt containe at the leaſt foure hand breadths. And hauing drawne thorow the center thereof the line A B C, diuide the circumference into two equall parts, in the point E; as likewiſe you muſt diuide the quadrant E C in the very midſt by the point F. Then muſt you diuide the arch E F into 90 equall parts, diuiding it firſt into three, and euery of theſe three into other three, and euery of thoſe nine into two, and each of thoſe two into fiue, which you muſt doe with much preciſenes and care. Then laying your ruler to the point B (which is the center) through euery one of thoſe 90 diuiſions of the halfe quadrant you muſt draw 90 lines: And keeping this quadrant ſo diuided, it will ſerue you for a paterne to make as many Croſſe-ſtaues as you think good, of what bignes ſoeuer you will. But to make the Croſſe-ſtaffe, you muſt take a peece of wood of ſome three foote in length, and a finger thick, foure ſquare, and very euen: and fitting a tranſuerſarie

thereto, which may with facilitie ſlide vp and down vpon the ſtaffe, alwaies right acroſſe; take with your compaſſes halfe the length of the tranſuerſarie, and placing one foote of the compaſſes vpon the point B, make with the other a marke in the line B C, which may ſerue for the point G, and draw thorow the point G the line G I, which may runne equally diſtant from the line E B. Finally, laying one end of the ſtaffe vpon the point G, let it lie all along iuſt vp-



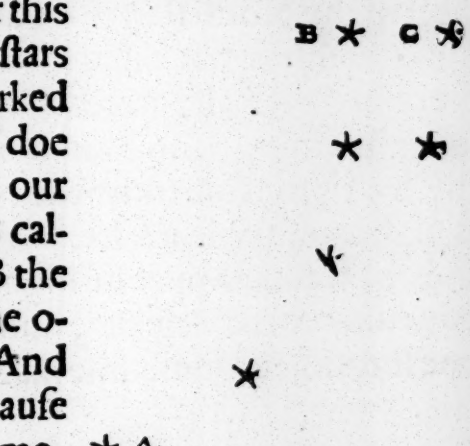
on

on the line G I, and make you markes vpon the edges of the ſtaffe, by which you may draw 90 lines, putting the number of euery line, vpon the ſaid edge, beginning to place 90 where the line BE doth croſſe the ſtaffe, and from thence deſcending vnto one or two, which may be put downe according to the length of the ſtaffe and the largeneſſe of the tranſuerſarie.

Chap. XII.

Of the poſition of the North ſtarre, and the guards.

AMongſt the 48 conſtellations, which the Aſtronomers place in the heauens, the neereſt vnto the pole of the world is that which they call the leſſer Beare, and the mariners Bozina, or ỹ horne, in regard of the faſhion thereof: which conſtellation conſiſteth of 7 ſtars, which are placed after this maner: And of theſe ſtars the three greateſt marked with the letters ABC doe ſerue eſpeciallie for our purpoſe. And ſo A is called the North ſtarre; B the formoſt guard; C the other guard behinde. And they are ſo called, becauſe that by force of the motion of the firſt moueable heauen the ſtarre B goeth



alwaies

alwaies before, and the ſtarre C behinde. Euery of theſe three ſtarres as well as al others in the heauens beſides, deſcribe their circles round about the pole, with the motion of the firſt, or higheſt moueable heauen: in which motion, ſometimes the two ſtars A B are iuſt of one heigth aboue the Horizon: and then they are ſaid to be Eaſt and Weſt one from an other. Sometimes they are in a perpendicular line to the Horizon according to our ſight; and then they are ſaid to bee North and South: and ſometimes alſo the two guards B C are Eaſt and Weſt one from another, and then the former guard beareth from the North ſtarre Northeaſt and Southweſt. And when theſe two guards be in a perpendicular line one aboue another, the former guard beareth from the North ſtar Northeaſt and Southweſt. In ſo much that from theſe foure poſitions do ariſe eight rules for the eight rumbes, wherein the former guard may ſtand, being conſidered in reſpect of the North ſtarre. And ſo preſuppoſing that the Northſtarre is diſtant from the pole three degrees and an halfe (according to the opinion of ſome mariners, who loue numbers that haue not any fractions) ſometime the North ſtarre ſhall bee as high as the pole it ſelfe, ſometime three degrees and one ſecond lower or higher then the pole, and ſometime three degrees, and ſometimes one and one ſecond, and ſometime halfe a degree.

CHAP.

Chap. XIII.

Of the heigth of the ſtarre taken with the Croſſe-ſtaffe.

TO know how much the North ſtarre is eleuated aboue the Horizon, you muſt take the heigth thereof onely at ſuch times when as in reſpect of the former guard it is in ſome one of theſe foure rumbes, that is to ſay, North and South, Eaſt and Weſt, Northeaſt and Southweſt, and Northweſt and Southeaſt. Wherefore ſeeing it placed in any of the foreſaid rumbs, you ſhal put that end of the Croſſe-ſtaffe which is next 90 degrees vpon your cheek-bone, at the vtter corner of your eye: & holding it there ſtedfaſt, you muſt moue ſ transuerſarie till you ſee the Horizon ioyned with the lower end thereof; and the North ſtarre with the higher end. Then marke the degree, and part of the degree which the tranſuerſarie ſheweth vpon the ſtaffe; for that is the heigth of the ſtarre.

Chap. XIIII.

The regiment or rules of the North ſtarre.

The firſt rule.

WHen the guards are in the Eaſt, the former guard beareth with the North ſtarre Eaſt and Weſt; and then the North ſtarre is a degree and halfe vnder the pole: let vs adde this degree and one ſecond to the heigth which we obſerued

ued with the Croſſe-ſtaffe; and the whole product ſheweth the number of degrees which the pole is eleuated aboue our Horizon. And ſo much are we diſtant from the æquinoctiall toward the North.

The ſecond rule.

When the guards are in the Northeaſt, one guard beareth from another Eaſt and Weſt: and the former guard ſtandeth from the North ſtarre Northeaſt and Southweſt; and then the North ſtarre is vnder the pole three degrees and one halfe; which being added to the heigth of the ſtarre, will ſhew you the heigth of the pole.

The third rule.

When the guards be at the higheſt, then the former guard beareth from the north ſtarre north and ſouth, the north ſtarre being then three degrees vnder the pole: which three degrees being added to the heigth of the ſtarre, doe ſhew the true heigth of the pole.

The fourth rule.

When the guards are in the northweſt, they beare one from another north and ſouth, and the former guard lieth from the north ſtarre northeaſt and ſouthweſt: and then the north ſtarre is vnder the pole halfe a degree: which halfe degree being added to the heigth of the ſtarre, giueth you the heigth of the pole.

The fifth rule.

When the guards are in the eaſt, the former guard lieth from the north ſtarre eaſt and weſt, and then the north ſtarre is a degree and an halfe aboue the pole;

pole, which degree and an half being deducted out of the heigth of the north ſtarre, the remainder is the iuſt heigth of the pole.

The ſixth rule.

When the guards are in the ſouthweſt, one beareth from another eaſt and weſt, and the former lieth from the north ſtarre northeaſt and ſouthweſt, and then the north ſtarre is aboue the pole three degrees and an half: which three degrees and an half being deducted out of the heigth of the ſtarre, that which remaineth ſhall be the heigth of the pole.

The ſeuenth rule.

When the guards are at the loweſt, the former guard beareth with the north ſtar north and ſouth: and then the north ſtarre is aboue the pole three degrees; which being deducted, the remainder is the heigth of the pole.

The eigth rule.

When the guards are in the ſoutheaſt, one beareth from another north and ſouth, and the former beareth from the north ſtarre northweſt and ſoutheaſt, and the north ſtarre is aboue the pole halfe a degree: which halfe degree being deducted from the heigth of the ſtarre, the remainder is the heigth of the pole aboue our Horizon, and iuſt ſo much are we diſtant from the æquinoctial towards the north.

This is the account which alwaies hath bin made of the north ſtarre from the time that it hath had three degrees and an halfe diſtance from the pole vnto this preſent. But becauſe at this time by reaſon of the compound motion of the 8 and 9 heauens, the fixed ſtarres haue notably varied from their

places,

places, the pole ſtarre hath alſo approched neerer the pole, being now diſtant therefrom not aboue three degrees and eight minutes. And ſo I thinke it conuenient to ſet downe the account which ought now to be made thereof according to the foreſaid diſtance: to the end that from hencefoorth the heigth of the pole taken by the ſtarre may agree iuſtly with the diſtance from the æquinoctial taken by the Sun. Which two things haue hitherto diſagreed and cauſed no ſmall confuſion vnto the Pilots, and ſome error in nauigation.

In ſtead of all theſe rules of the North ſtar (which are erroneous) vſe the table of æquatiõs of the Pole ſtarres height, ſet downe in the latter end of this booke.

The guards being in the	East,	you ſhall adde vnto ỹ heigth taken by the Croſſe-ſtaffe,	1 degree 20 min.
	Northeaſt,		3 degrees 8 min.
	North,		2 degrees 41 min.
	Northweſt,		0 degree 27 min.

In the contrary rumbes to theſe you muſt deduct theſe degrees from the heigth of the ſtarre, which you take with your Croſſe-ſtaffe, and then you ſhall haue the heigth of the pole aboue the Horizon.

Chap. XV.

Other things to be noted in obſerning the heigth of the Pole.

NExt vnto the conſtellation of the Horne there is a ſtarre which is called by the Spaniards *el guion*, ſignified before by the letter D, which ſtanding eaſt and weſt from the north ſtar, giueth you to vnderſtand, that it, and the north ſtarre, and the very pole are eaſt and weſt. And ſo taking the heigth of the north ſtarre, when it is thus ſituate in regard of the *Guion*, without making any other

other account, you haue the iuſt heigth of the pole and the diſtance from the æquinoctiall.

Sometimes alſo it falleth out, that being verie neere vnto the line, or for ſome other cauſe, the guards cannot be ſeene how they lie from the north ſtarre. For remedie whereof there are three ſtarres, by which (ſeeing any of them and the north ſtarre, albeit you cannot ſee the guards) you may know the heigth of the pole, and theſe are the ſtarres which the mariners call the third, the ſixth, and the ninth. The third is the head of that conſtellation which the Aſtronomers call the Dragon, & it maketh with two other ſtarres that follow it, this figure: The ſixth is the right foote of *Cepheus*: and the ninth is the left foote. The third was ſo called, becauſe it commeth vnto euery third rumbe three houres after the former guard; and the ſixth is ſo called, becauſe it commeth ſixe houres after the former guard; and the ninth, becauſe it commeth nine houres after the former guard. Whereof it followeth, that when the third ſtarre is directly aboue the north ſtarre, the former guard is in the north-weſt, the ſixth ſtarre in the northeaſt, and the ninth in the eaſt. And to know this in the other rumbes, you may peruſe the table following; wherein is manifeſtly ſet down where the guards are, and how they are ſituate, in what rumbe ſoeuer any one of theſe three ſtarres is found. So that it will be an eaſie matter to know the place of the guards, and the heigth of the pole, the heigth of the pole ſtarre being found, and the place of the third, ſixth, or ninth ſtarre.

Here

Here followeth the Table.

The guards being in the	East Northeaſt North Northweſt Weſt Southweſt South Southeaſt.	The third ſtarre is in the	Southeaſt Eaſt Northeaſt North Northweſt Weſt Southweſt South.	The ſixth ſtarre in the	South Southeaſt Eaſt Northeaſt North Northweſt Weſt Southweſt	The ninth ſtarre in the	Southweſt South Southeaſt Eaſt Northeaſt North Northweſt Weſt.

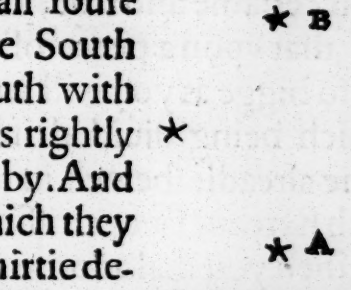
In this table the firſt columne ſerueth for the guards; the ſecond for the third ſtarre; the third columne for the ſixth ſtarre; and the fourth for the ninth ſtarre. In ſo much as if you ſeeke the rumbe, ſeeing any of theſe foure ſtarres in this table, right againſt the ſame doe anſwere thoſe rumbes where the other three are, although we cannot ſee them in the heauens.

Chap. XVI.

Of the Croſiers.

When the mariners paſſe the æquinoctiall line towards the South, ſo that they cannot ſee the North ſtarre, they make vſe of another ſtar, which is in the conſtellation called by the Aſtronomers the *Centaure*: which ſtarre, with other three notable ſtarres, which are in the ſame conſtellation, maketh the figure of a croſſe; for which cauſe they call it the *Croſier*. And it is holden for certaine, that when the

the ſtarre A (which of all foure commeth neereſt to the South pole) is North and South with the ſtarre B, that then it is rightly ſituate to take the heigth by. And becauſe this ſtarre A (which they call the Cocks foote) is thirtie degrees from the South pole, it commeth to paſſe that if being ſituate, as is aforeſaid, we take the heigth thereof (which is then the greateſt that it can haue) this heigth will truly ſhew how farre we are diſtant from the æquinoctiall. For if the ſaid heigth be thirtie degrees, then wee are in the very æquinoctiall: and if it be more then thirtie degrees, then are wee by ſo much paſt the æquinoctial towards the ſouth. And if it be leſſe then thirtie degrees, ſo much as it wanteth are we to the north of the æquinoctiall.



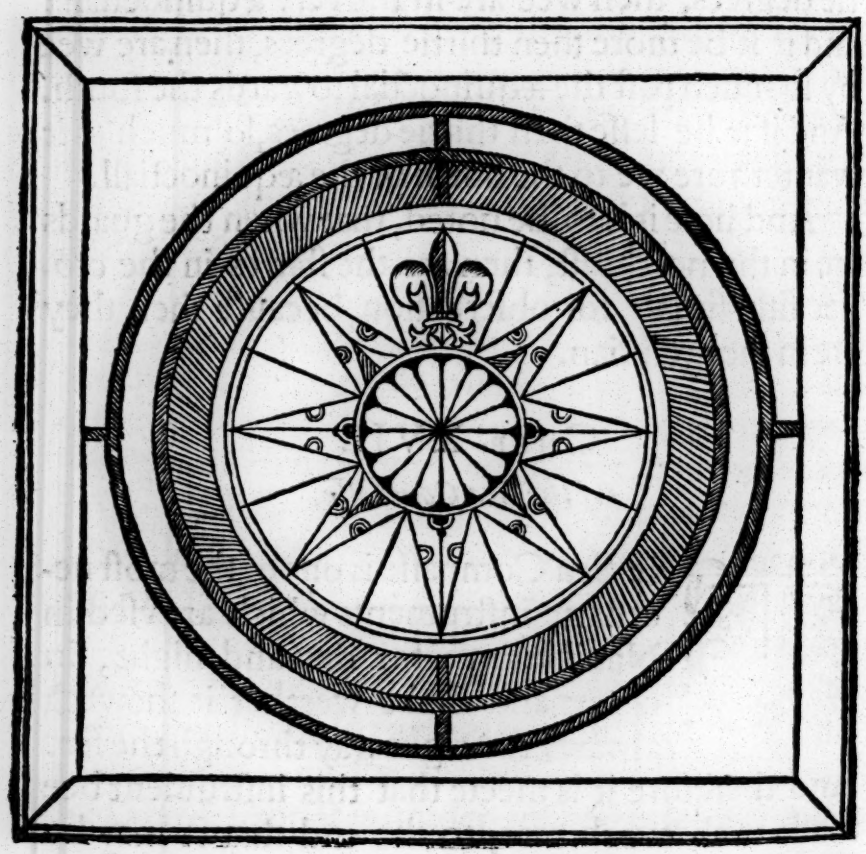
And here it is to be noted, that when the guards are in the northeaſt, then are the ſtarres in the croſier fitly ſituate for obſeruation, becauſe then they are in the meridian.

Chap. XVII.

Of the Sea Compaſſe.

THe Sea Compaſſe is one of the moſt neceſſarie inſtruments which are vſed in Nauigation: for day and night, in cleere and darke weather it ſheweth alwaies the right way through the ſea. And therefore it is meete that this inſtrument bee made with much care, to the end that it may be

moſt certaine and true. And the manner of making ti is, that vpon a peece of paſtboord, you draw a circle ſo bigge as you will haue your Compaſſe to be: which being diuided into 32 equall parts (as wee haue alreadie ſhewed in the Chapter of the winds) with ſixteene lines croſſing one another in the center, then you ſhal adorne the eight principall winds, as is to be ſeene in the figure following, ending in the North with a flower de lis: and you ſhall paint the North and South, and Eaſt and Weſt with blew, and the Northeaſt and Southweſt, and the Northweſt and Southeaſt with red. And then taking two



ſteele

ſteele wires, which are to be placed like the head of a launce, you muſt faſten them on the backſide of the ſaid circle, in ſuch ſort that one meeting of the points of thoſe ſteele wires be right vnder the north, allowing halfe a point towards the northeaſt, in regard of the northeaſting of the needle at Seuil: and the other meeting at the oppoſite point, which is ſouth, and half a point towards the Southweſt: and touching or rubbing thoſe two points of the wires with the ends of the Loadſtone, which looke to the north and to the ſouth, to wit, the north points of the wires with the ſouth of the ſtone; and the ſouth point of the wires with the north of the ſtone. This being done, you muſt place vpon the center of the ſaid circle a capitell, which muſt be very well bored in forme of a round piramis, to the end that the roſe or flie may play more nimbly vpon the pinne. This pinne muſt be made of latin with a very ſharp point, and is to be faſtned vpright in a round box of wood, which muſt bee of the faſhion of a great cup diſh, containing the roſe within it, being couered aboue with a cleere round glaſſe, and the ioynts thereof muſt bee ſtopped with wax, to the end that no winde may enter into the roſe to diſturbe it. There muſt be great care had, that this roſe, with the wires being placed vpon the pinne, may goe nimbly, and may not ſwarue more to the one ſide then to the other, but may ſtand euen and leuell. And when it inclineth towards either part, you muſt put on the contrarie part a little wax, or a thinne plate of lead faſtned vnder the paſtboord which couereth the wires. This box wherein the roſe plaieth vp and

downe hangeth within two hoopes of latin, which are two round circles incloſed one within another, and diſtant aſunder by the ſpace of halfe a fingers breadth, with two nailes of latin which are diametrally oppoſite. And the box being fitly placed within theſe hoopes, you muſt make in the outward hoope two holes, which muſt be diſtant from the foreſaid two nailes a quarter of a circle both waies: And by theſe two holes muſt the outward hoope or circle be faſtned within a ſquare box, or a round, ſo as although that vttermoſt box be toſſed vp and downe euery way with the motion of the ſhippe, yet alwaies the ſuperficies and glaſſe of the inner box may lie leuel with the Horizon. And this being done with care, the inſtrument, which they call the Sea Compaſſe, is fully finiſhed. The manner of vſing the ſame is, when being placed with the box in the midſt of the pup of the ſhip where the bittacle ſtandeth in a right line, which paſſeth from the boltſprit by the midſt of the maine maſt to the puppe, it ſerueth continually to gouerne the ſhip by mouing of the rudder, till the winde or the line of your compaſſe, towards which we deſire to ſhape our courſe, ſtand directly towards the prow or boltſprit of the ſhip. They vſe alſo for the night to marke a point within the inner part of the inner box, which in reſpect of the capitell of the compaſſe, may ſtand directly towards the prow of the ſhip: And alwaies in guiding the ſhippe, you muſt take heed that the ſaid point be continually ioyned with the winde of the roſe towards which you intend your courſe.

CHAP.

Chap. XVIII.

How the variation of the Compaſſe may be found.

THe mariners vſe to examine whether their compaſſe northeaſteth or ſouthweſteth, watching for that purpoſe, when the former guard beareth with the north ſtarre northeaſt and ſouthweſt, taking a little of the point of north and ſouth. And placing their compaſſe in an open place, where the north ſtarre may be ſeene, if the flower de-lis of the roſe looketh directly towards the ſtarre, their compaſſe varieth nothing at all: but if the ſtarre be to the northeaſt, ſo much as it varieth from the point of the flower de-lis, ſo much the compaſſe northweſteth: and if it varieth to the northweſt of the compaſſe, how much the ſtarre ſwarueth from the point of the flower de-lis, ſo much the compaſſe northeaſteth. And in regard of this variation of the compaſſe there muſt alwaies allowance be made in the courſe which is holden. This manner of finding out the variation I do account to be ſomewhat ſubiect vnto error: but at land there is another more certaine way by the meridian line, which is to be taken in manner following.

The finding of the meridian line.

In a ſuperficies which is plaine and leuell euery where, and in a place where the Sunne ſhineth at

his riſing and ſetting, you muſt draw certaine circles vpon one center: and hauing pitched a ſtile vpright in the ſame center (the head whereof muſt be approued with a paire of compaſſes to be equally diſtant from all parts of one of thoſe circles) obſerue you in the morning two or three houres before noone, when the point of the ſhadow of the ſtile toucheth the circumference of any of thoſe circles: & hauing made a mark in the touches, take diligent heed in the after noone alſo when the ſame point of the ſhadow turneth about to touch in the ſame circle, and making another mark in that ſecond touch, diuide in the midſt that part of the circle, which is betweene thoſe two markes. Then laying your ruler vpon the point of the diuiſion, and vpon the center of thoſe circles, draw a line, which ſhall be your meridian and the true north and ſouth rumbe; vpon which ſetting your compaſſe, and laying your ruler ouer the glaſſe that it may paſſe along ouer the meridian, and ouer the center or capitell of the roſe or flie: either the ſaid ruler lieth ouer the north and ſouth of the Compaſſe (and then is the Compaſſe without variation) or the ruler declineth toward the northeaſt or ſouthweſt; and how much it declineth that way, ſo much the compaſſe northweſteth: or elſe it declineth towards the northweſt, and then it northeaſteth ſo much as the ruler declineth that way. But to know the variation of the Compaſſe both at land and ſea, wee will deliuer another farre more eaſie and certaine way, when we come to intreate of the vniuerſall Diall.

CHAP.

Chap. XIX.
Of the Sea-chart.

THe Sea-chart is nothing elſe but a liuely picture of the earth and water. And it containeth fiue notable things, which doe concerne as well the true making of the Chart, as alſo the inabling of the mariner to know the way which hee maketh, the place where he is, and the end of his iourney.

The firſt is the laying out of the coaſts of the land; which that it may be truly done, it is meete that euery thing bee ſet downe in the Chart in the ſame courſe, diſtance, and heigth that ſhall be found in nauigation.

The ſecond is, that it containeth not onely the coaſt of the firme land, but alſo all other particularities which doe occurre in ſailing, as namely, Ilands, Iſelets, bankes, or barres, ſhoulds, rocks and flats.

The third is the lines which ſignifie the 32 winds, by the helpe whereof we may ſee whether the parts of the land be well laid out, and in their true courſes one from another. And of theſe windes the blacke are the eight principall, which are called whole windes. The greene be halfe windes, or half parted windes: and the red be the quarters of the windes. You may know in your chart whether theſe windes be well drawne, if you trie with your compaſſes that all points of them be equally diſtant one from another: and that all windes repreſenting the ſame rumbe be parallels: As namely, that one northeaſt

and ſouthweſt rumbe be parallel to another northeaſt and ſouthweſt rumbe. The fourth is the graduation, in all parts whereof it is meete that the degrees * be equall one to another: and that the parts of the land do directly lie eaſt and weſt from thoſe degrees vnder which they are ſituate. The fifth is the ſcale of leagues, which you may ſee whether it be true, by taking betwixt the points of your compaſſes iuſt foure degrees out of the line of graduation, which being applied to the ſcale of leagues, muſt there agree exactly with 70 Spaniſh leagues, or 80 Engliſh.

* Or rather increaſed proportionally from the æquinoctial line towards the North and South.

By the Sea-chart are knowne fiue things: The firſt is the lying or trending of the coaſt. The ſecond is the diſtance or number of leagues from one coaſt to another. The third is, the latitude or diſtance frõ the æquinoctiall, wherein all lands both continents and Ilands, as alſo euery port, riuer, ile, ſhoald, or banke is ſituate. The fourth is the rumbe or rumbs, by which we are to ſaile from one place to another. The fifth is the point or place where wee are with our ſhip when wee are ſailing. The firſt is knowne with a paire of compaſſes, putting one foote thereof vpon the beginning of the coaſt whoſe trending we deſire to know, and the other foote vpon the rumbe which to our thinking is euery where equally diſtant from the ſaid coaſt. For if one foot of the compaſſes running along the coaſt, the other foote keepeth by the ſaid rumbe, then we ſay the coaſt lieth euen with that rumbe. And if our Compaſſe runneth without ſwaruing one foote from the rumbe, and the other from the coaſt, till the point which runneth

runneth along the coaſt leaueth it, then from that very place where it leaueth the ſame, wee may ſay that vnto the other place where it began, the coaſt runneth by ſuch a rumbe, as if a man ſhould ſay eaſt and weſt, northeaſt and ſouthweſt, or any other rumbe whatſoeuer.

The ſecond thing (which is the diſtance) may be found by taking betweene the points of your compaſſes out of your ſcale of leagues, (if the diſtance be very great) an hundred leagues, and meaſuring with your compaſſe ſo opened from one place to another: now if in ſo doing it falleth not iuſt, then remembring how many hundreds of leagues there are, you muſt for the meaſuring of the reſt pitch one foote of your compaſſe vpon the point where the laſt hundred ended, and the other foote vpon the land, whoſe diſtance you deſire to know: the bringing the compaſſe ſo opened to the ſcale of leagues, you ſhall ſee manifeſtly how many leagues the ſaid diſtance ſurmounteth aboue the hundreds. But if the diſtance be leſſe then an hundred leagues, then ſetting the points of your compaſſes vpon thoſe two places whoſe diſtance you deſire to know, and remouing the compaſſe ſo opened to the ſcale of leagues, you ſhall eaſily know the diſtance of one of thoſe places from the other.

The third (which is the heigth or latitude wherein euery port, riuer or Iland ſtandeth) is to be found by pitching one foote of your compaſſes vpon the land, hauen, or cape, whoſe heigth you deſire to know, and the other foote vpon the next eaſt and weſt parallel, and the compaſſe remaining in that

ſort,

ſort, moue the point thereof along the ſaid parallel, or rumbe, to the line of graduation, and there the other foote which lay vpon the land will ſhew you the heigth thereof.

The fourth (which is the rumbe or rumbes by which you muſt ſaile from one place to another) is knowne after this manner: If you be to ſaile by one rumbe only, you may know it by pitching one foot of your compaſſes vpon the place from which you are to depart; and the other foote vpon the verie next rumbe, which to your thinking goeth moſt directly to the place whither you would go; and running by that rumb with one foote of your compaſſe ſo opened, the other foote will touch the place whither you are going. But if it toucheth not the place whither you are going, then pitch one foote of your compaſſes vpon the ſame place, and the other foote vpon the ſecond rumbe, which you ſuppoſe may leade you thither: And placing one foote of another paire of compaſſes vpon the place from whēce we depart, and the other vpon the moſt direct rumb toward the place deſired; theſe two compaſſes running along the rumbes one toward another; you muſt marke where thoſe two points ioine together, one whereof came from the place of your departure, and the other from the place whither you are to goe; and the point where they both concurre is that to which we are to change our courſe.

As for example, if I ſaile from the barre of S. *Lucan*, to fall with *Punta de Naga* vpon the Ile *Teneriſe* in time of winter; it is euident that I muſt ſaile ſouthweſt and by ſouth, till I bring my ſelfe eaſt and weſt with

with *Cape Cantine* in 32 degrees and an halfe: and from thence I muſt goe ſouthweſt and by weſt: but not all the way, becauſe putting one point of the compaſſe vpon *Cape Cantine*, and the other point vpon the ſouthweſt and by weſt rumbe next vnto it, my compaſſe thus running open alongſt the ſaid rumbe, the point which departed from *Cape Cantine* will runne on the outſide of *Punta de Naga*. But in ſuch a caſe as this I place one point of one paire of compaſſes at *Punta de Naga*, and the other point vpon the ſouthweſt rumb: Likewiſe I place one point of another paire of compaſſes at *Cape Cantine*, and the other vpon the next ſouthweſt and by weſt rumb. Then let theſe two compaſſes ſo opened run by their ſaid rumbes one againſt another, and then you muſt looke in what place and heigth the verie point is, where thoſe two points of the compaſſes which departed from *Punta de Naga* and *Cape Cantin* doe meete: and I ſay, that when I am come to the ſaid heigth and place, hauing ſailed from *Cape Cantine* ſouthweſt and by weſt, then I muſt change my courſe and runne ſouthweſt.

Chap. XX.

Of the point of imagination.

THe fifth thing to be knowne by the Sea-chart is the point of the ſhips place, and this they terme to caſt a point, or to ſet a prick vpon the chart: which is no other thing but to finde a point therein which is proportionally diſtant in the chart from all the lands

and

and Ilands there deſcribed ſo many leagues of the ſcale, as there are leagues of diſtance vpon the ſea from the place where you are to the lands, and Ilands round about you, repreſented by theſe that are in the chart. This point is to bee found two waies; either by imagination, or by trauerſing, which may properly bee called geometricall. The point of imagination is vſually found by the firſt of theſe two waies when we ſaile directly by a parallel circle; which is when wee ſaile due eaſt, and weſt, keeping alwaies in one heigth and diſtance from the æquinoctiall: or when we ſaile by any other rumb in cloſe weather, when neither the Sunne at noone, nor the north ſtarre in the night can be ſeene.

This point doth preſuppoſe the knowledge of two things; to wit, the rumbe by which wee haue ſailed, and that is knowne by the Compaſſe, and the leagues which we haue runne; and this hath no certaintie, but is a little more or leſſe then a good mariner, according to his imagination ſuppoſeth that hee hath ſailed, whereof the ſaid point tooke his name.

This point is found in the chart, by taking out of the ſcale of leagues ſo many leagues as a man can well eſtimate that the ſhip hath gone: and pitching one foote of the compaſſe in the place from which you departed, you ſhall ſet the other point in ſuch ſort, that both may bee equally diſtant from the rumb or winde whereby you haue ſailed; & where that ſecond point of your compaſſe ſhall fall, there is your ſhip according to your imagination.

Chap. XXI.

Of the trauerſe or Geometricall point.

THe point found by imagination is not ſo certaine as is conuenient, becauſe it oft commeth to paſſe, either becauſe the mariner hath not made true account of the way that his ſhip hath made, or for ſome other cauſes therewith concurring, that if hee taketh the heigth by the Sun, or by the north ſtarre, after he hath caſt his point, he commeth not to find himſelf in that diſtance from the æquinoctial, which his point of imagination doth ſhew him, but in ſome other diſtance. And to auoid this error there is another way of caſting your point in the chart, which is called *punto de eſquadria* (the trauerſe point) which point preſuppoſeth the aſſured knowledge of two things; one is the rumbe by which you haue ſailed, the other is your diſtance from the æquinoctiall.

For all this art of Nauigation is grounded vpon the courſe, and height which is in quantitie all one with the diſtance from the æquinoctiall. The rumb or courſe is alwaies knowne by the compaſſe, the height by the ſtarre, and the diſtance from the æquinoctiall by the Sunne.

This being knowne, ſet the foote of one compaſſe at the port or place from whence you departed, and the other foote in the next rumbe whereupon you haue ſailed: and placing one point of an other paire of compaſſes vpon the line of graduation,

tion, in the degree of your diſtance from the æquinoctiall, and the other point vpon the next eaſt and weſt rumbe, let theſe two paire of compaſſes ſtanding thus open, runne along the rumbs, one towards another, till the point which came from the place of your departure, and that other which came from the height of your graduation, meete: and where they meete, there is the place of your ſhip. And this point ſo found out, is moſt certain, when the height is carefully taken, and the rumbe knowne.

Chap. XXII.

Of the amending of the point of imagination.

He that knoweth how to finde out the point by trauerſing, ſhall eaſily amend the point of imagination, when hauing taken his height, hee findeth the ſaid point not to be good, and certaine. And heere is to bee noted, that when you ſaile eaſt and weſt, and finde the point by imagination, this point cannot bee amended, but you muſt ſaile in doubt how many leagues you haue gone, vntill you fall with the land; becauſe that ſailing in that courſe neither the height of the pole, nor your diſtance from the æquinoctiall, doth any whit alter. But when you ſaile by any other rumbe, your point of imagination may bee amended, and the amendment thereof ſhall be ſo much the more certaine as the rumbe of your nauigation commeth neerer to the north or ſouth, and by ſo much the more vncertaine as it commeth neerer to the eaſt or weſt. Thi samendmẽt is made two maner of waies, namely,

namely, either by trauerſing, or by the amendment of north and ſouth, and eaſt and weſt; which ſecond amendment though it be a kinde of trauerſing, yet is it called by another name, to diſtinguiſh it from the firſt.

The amendment of the point of imagination by the trauerſe point.

When you will amend your point of imagination by trauerſing, you muſt ſet one foote of one paire of compaſſes in the point found by imagination, and the other foote vpon the next rumbe by which you haue ſailed: and ſetting the foote of an other paire of compaſſes in the line of graduation vpon the number of degrees, which you finde your ſelfe diſtant from the æquinoctiall, and the other foote vpon the next eaſt and weſt line; runne with your compaſſes ſo opened by the foreſaid rumbes, till the point proceeding from the graduation, and the other which proceedeth from the point of imagination doe meete iuſt together, and then you may ſay that your point of imagination is mended by trauerſing.

The amendment of the point of imagination by North, South, Eaſt, Weſt.

The amendment by north, ſouth, eaſt, weſt, is after this manner: Set the foote of one compaſſe vpon the point found by imagination, and the other foote vpon the next north and ſouth rumbe: then place

place one foote of another compaſſe in the line of graduation vpon the degree wherein you find your ſelfe, and the other vpon the next eaſt and weſt rumbe, and ſo let theſe two compaſſes runne thus open by their rumbs, till the point which commeth from the point of imagination, and the other which commeth from the graduation doe meete; for then is your point of imagination amended by the amendment of eaſt, weſt, north, ſouth.

Of theſe two amendments the firſt ſerueth when you ſaile in a large gulfe, becauſe you may runne at libertie with the compaſſe: the ſecond ſerueth neere vnto any coaſt.

Chap. XXIII.

The point by imagination and the height.

When you ſaile by the ſixth or ſeuenth rumbe, that is, by the eaſt and by north, or eaſt and by ſouth, or by the weſt and by north, or weſt and by ſouth: or elſe by the eaſt northeaſt, or weſt ſouthweſt, or by the eaſt ſoutheaſt, or weſt northweſt; there is a certaine difficultie which may breed great error in finding the trauerſe point, notwithſtanding the latitude be taken, by reaſon of the rudder that guideth the ſhip, which giueth certaine yawes out of the courſe that the Pilot pretendeth, or by reaſon of the winde which bloweth not right in the pup, but maketh the ſhip fall to the leeward, from the direct and true courſe which it ought to keep. Wherefore becauſe in ſuch a caſe, if you finde your point by

by trauerſing, ſuppoſe by eaſt and by north, the way which I thinke is made and hath been ſailed may be by the eaſt northeaſt: which point ſo found, muſt ſtand more forward then the true point, by ſo much difference as there is betweene 42 and 88 Spaniſh leagues, which is 46 leagues, that is the difference of diſtance from the meridian or north and ſouth line in thoſe two points. In ſuch a caſe as this, it is not meete to find your point by trauerſing, to auoid the error which hereupon may enſue, which error ariſeth of ſuch a cauſe, as that a mans iudgement, be it neuer ſo good, cannot eaſily determine thereupon, and ſo conſequently he cannot iudge preciſely. But to auoid confuſion and cauſe of error, hee muſt caſt his point in manner following, and hee ſhall erre as little as is poſſible.

Let him examine according to the ordinary running of his ſhippe, how much way ſhe might make euery day that hee hath ſailed; and the leagues that ſhall amount in all the daies, let him take between the points of one compaſſe: and let him place one point thereof vpon the place from whence hee departed: and taking another compaſſe, let him ſet one point thereof vpon the graduation, according to the heigth which hee hath taken, and the other point vpon the next eaſt and weſt rumbe. Now let this compaſſe runne by his eaſt and weſt rumbe, till the point comming from the graduation meete with the ſecond point of the other compaſſe which hee holdeth not vpon the Chart: and in the place where they meet, he may ſay that there is his point, and his ſhip.

And becauſe in this caſe all Pilots doe not vſe this point of imagination and height, there grow great diuerſities among them concerning their diſtance from land, when as in long voyages they conferre and communicate their opinions one with another; in ſo much that one according to his coniecture iudgeth himſelfe to be 50 leagues from land, another 100, another 200, and another thinketh hee is hard by the land. The reaſon is, becauſe ſome of them caſt their point by trauerſing, others by imagination only, and others by imagination and height, who are alwaies more certaine then the reſt.

Chap. XXIIII.

What it is to increaſe or diminiſh in height.

THe mariners call it increaſing in height when they go further and further from the æquinoctiall; and diminiſhing in height when they approch neerer to the æquinoctiall. So that in our nauigation wee either ſaile from a greater to a leſſe altitude of the pole, and then we goe towards the æquinoctial, and then the height is ſaid to be diminiſhed: or we ſaile from a leſſe to a greater height of the pole, and then we goe frō the æquinoctial, and are ſaid to increaſe our height. And hence it is that caſting our point by imagination, and afterwards (hauing taken the height) amending it by trauerſing; either the height wherein we finde our ſelues being taken by the Sun or ſtarre is greater, or elſe it is leſſe then that which wee made account of by imagination. And hence doe

doe ariſe foure rules: The firſt is, that when in ſailing wee doe increaſe the height, if the point amended by trauerſing be of greater height then the point of imagination, the ſhip hath gone more then the point of imagination ſhewed vs.

The ſecond: when we increaſe our height, if the point amended by trauerſing be in leſſe height then the point found by imagination, then hath the ſhip gone leſſe way then we imagined.

The third is, when we diminiſh our height in ſailing, if the point amended by trauerſing be in a greater height then the point found by imagination, then hath the ſhippe made leſſe way then we geſſed by our imagination.

The fourth is, when wee diminiſh our height, if the point amended by trauerſe bee in leſſe height then the point found by imagination, then hath the ſhip made more way then we imagined.

Chap. XXV.

How you may caſt a trauerſe point without Compaſſes.

IF a mariner chance to loſe his compaſſes, he may caſt his point of trauerſe after this maner: Let him take two ſlender threeds, and putting the end of one of them vpon the place from whence hee departed, let him ſtretch it in equall diſtance from the rumbe by which hee hath ſailed, and putting another threed in equall diſtance from the next eaſt and weſt rumbe, let him make it to paſſe by the degrees of height in which

he findeth himſelfe; and where the two threeds croſſe one another, there is the point of the ſhip: and alwaies the firſt threed (if it hath not changed the courſe) ſheweth the way which the ſhip hath gone, and the ſecond the parallel wherein the ſhip is.

Chap. XXVI.

Of another kind of caſting a point by trauerſe.

EXamine the difference of the degrees of diſtance from the æquinoctiall, which are betweene the place from whence the ſhip ſet foorth, and the place where the ſhip is: Then taking the heights of both places very preciſely, and ſubtracting the leſſer out of the greater, that which remaineth is the difference: which difference you muſt multiplie by the leagues, which anſwere to one degree in the rumb by which you haue ſailed, and thoſe leagues which the degrees and minutes of difference ſhall make, you ſhal take betweene the points of a paire of compaſſes out of your ſcale of leagues. And holding the ſaid compaſſe ſo open, ſet one foote thereof vpon the point from whence the ſhip departed, and the other foote ſtretching towards the place whither the ſhip hath ſailed, you muſt hold vp a little from the chart: and you muſt ſet one foote of the other compaſſe at the degree of the diſtance wherein your ſhippe is from the æquinoctial, when the ſaid point is ſought for, and the other point you muſt place vpon the next eaſt and weſt parallel. And let this ſecond compaſſe runne by his next eaſt and weſt rumbe, vntill the

the point of the first compasse lifted vp, being set downe, that point of the second compasse which came from the said degree doth meete therewithal: and where those two points shall meete, there is the true point of the ship.

Chap. XXVII.

Of the leagues which in nauigation answere to each degree of latitude in euery rumbe.

IF we suppose (as wee haue before said in the chap. of the quantitie of ỹ earth) that the greatest circle thereof containeth in compasse 6300 commõ Spanish leagues, then vnto euery degree of the meridian (which is the greatest circle) doe answere 17 Spanish leagues and an halfe: so that sailing north and south, if your heigth of the pole, or your distance from the æquinoctiall be varied one degree, you may say that you haue gone seuenteene leagues and an halfe: but if you varie one degree, and hold your course vpon the first point, then haue you sailed 17 leagues and $\frac{5}{6}$. And you haue declined from the meridian or right line which passeth by the place from which you departed, three leagues and an half. And if you saile vpon the second point from the north or south till your heigth of the pole be changed one degree, you haue then gone 19 leagues and $\frac{3}{8}$, and are distant from your right line 7 leagues and $\frac{1}{4}$. And varying a degree vpon the third point of the Compasse from north or south, you haue gone 21 leagues, and are departed from your right line 11 leagues and $\frac{2}{3}$.

Sailing vpon the fourth point of the Compaſſe, there doe anſwere vnto euery degree 24 leagues and three fourths, and you are diſtãt from the right line or meridian 17 leagues and an halfe. Vpon the fifth point you muſt allow for one degree 31 leagues and an halfe, and then are you diſtant from your right line 26 leagues and $\frac{1}{5}$. Vpon the ſixth point doe anſwere vnto one degree of latitude 45 leagues and $\frac{3}{4}$, and you are then parted from your right line 42 leagues and $\frac{1}{4}$. Vpon the ſeuenth point doe anſwere vnto one degree of latitude 89 leagues and $\frac{3}{4}$, and you are departed from your right line 88 leagues, as it appeareth out of the table following.

The table of the Author which is more preciſe.

Leagues of the courſe or rumbe.		*Diſtance from the right line.*	
1	17	$\frac{5}{6}$	3	$\frac{1}{2}$
2	19	$\frac{3}{8}$	7	$\frac{1}{4}$
3	21		11	$\frac{2}{3}$
4	24	$\frac{3}{4}$	17	$\frac{1}{2}$
5	31	$\frac{1}{2}$	26	$\frac{1}{5}$
6	45	$\frac{3}{4}$	42	$\frac{1}{4}$
7	89	$\frac{3}{4}$	88	

The old table which is leſſe certaine.

Leagues of the courſe or rumbe.		*Diſtance from the right line or meridian.*	
18		3	$\frac{1}{2}$
19	$\frac{1}{2}$	7	$\frac{1}{2}$
21	$\frac{1}{2}$	11	$\frac{2}{3}$
25		17	$\frac{1}{2}$
31	$\frac{1}{2}$	26	$\frac{1}{2}$
46	$\frac{1}{2}$	42	$\frac{1}{2}$
88		85	

Chap. XXVIII.

How you may come to know the longitude or the courſe from eaſt to weſt.

That which the Coſmographers call longitude, is called by the mariners the diſtance from the right

right line, and the course of east and west, and the heigth of east and west, and it is a part of an east and west rumb contained betweene two meridians, one of which runneth by the point or place from whéce we departed, and the other by the point where the ship is. This distance from the right line is knowne by the meane of two things, namely of the course and of the difference of latitude, or of the course and distance.

The course and the difference of the heigth being giuen, you may know the said distance by trauerse or by numbers. By geometrie, or trauerse it is knowne in manner following: The heigth, or the distance of your ship from the æquinoctiall being knowne, and the rumbe also vpon which you haue sailed, you must cast vpon your chart a point by trauerse, and placing vpon that point one of the points of your compasses, and the other vpon the next rumbe of east and west; you must place one point of another paire of compasses at the hauen or point from whence the ship departed, and the other point vpon the north and south rumbe which is next. These two compasses thus opened, running by their rumbes one towards another, you must marke where the two points meete; namely, that which came out of the part from whence you departed, and that which you remoued from the point where the ship presently is, being found by trauerse: and where those two points doe meete, there make another point or prick. Then looke how many leagues there are from the said third point to the point of trauerse where the ship is, (both which doe alwaies

beare east and west one from another) so many leagues is your distance from the right line. And if in stead of the leagues set downe in the scale wee measure with degrees taken out of the graduation, *we shall haue the degrees of longitude, which are between the point of our departure, and the point of the place where presently we are.*

* This for the most part is not true in the ordinary Sea-chart.

And it is to be noted, that alwaies when we saile, wee either alter our latitude only, and that is when we saile north and south, or wee alter the longitude only, that is, when we saile by the self same latitude, going alwaies east and west by the same parallel: or we alter both latitude and longitude, when we saile by any of the other 28 windes. When wee alter the latitude only we swarue not one iot from the right line or meridian; when wee alter both longitude and latitude, then must wee finde the longitude or distance from the right line in manner aboue said.

But when your longitude only is altered, because then you must finde out the point where the ship is by imagination only, there is no certaine manner to know the longitude or distance from the right line, but only little more or lesse, setting downe a point by imagination, and measuring by leagues, or by degrees, what distance there is betweene that, and the point from which the ship departed. By numbers you may finde out the longitude in manner following: The difference of your distance from the æquinoctiall being knowne, which is so many degrees more or lesse, as you haue increased or diminished in the heigth of the pole, looke in the table annexed to the chapter next before this, for the leagues of

distance

distance from the right line which answer vnto one degree by the rumbe or point of the compasse vpon which you haue sailed; and multiplying those leagues by the number of degrees which you haue increased or diminished in the heigth of the pole in your nauigation, you shall then see how many leagues you are distant from the right line, which passeth by the place from whence you came; which leagues if you diuide by $17\frac{1}{2}$, then will appeare vnto you the degrees of longitude betweene the place from whence you departed, and the point where you are.

Chap. XXIX.

How you may set downe in your Chart a new land neuer before discouered.

IT may sometimes fall out in new discoueries, or when your ship by meanes of a tempest is driuen out of her right course, that you shall come to the sight of some ile, shoald, or new land, whereof the mariner is vtterly ignorant. And to make some relation of the same, or to goe vnto it some other time, if you desire to set it downe in your Sea-chart, in the true place, you may doe it after this manner: So soone as you haue sight thereof, marke it well first with your compasse, obseruing diligently vpon which point therof it lieth. And secondly you must there take the heigth of the Sun or of the pole starre, that you may know in what point your ship is, and that point you must call the first point; which being so

ſo done, your ſhippe may ſaile on her courſe all that day, till the day following, without loſing her way: and the next day marke the land againe, and ſee vpon what point it lieth, and then take your heigth, and with it caſt your point of trauerſe once againe; and that you may call your ſecond point. Then take a paire of compaſſes, and placing one foote vpon the firſt point, and the other vpon the rumbe towards which the land did beare, when you caſt your firſt point: ſet alſo one foote of another paire of compaſſes in the ſecond point, and the other foote vpon the rumbe vpon which the land lay when you caſt your ſecond point; and theſe two compaſſes thus opened, you muſt moue by their rumbes, till thoſe two feete of both compaſſes doe meete together, which were moued from the foreſaid two points: and where they doe ſo meete together, there may you ſay is the land which you diſcouered; which land you may point out with the inlets and out-lets, or capes and other ſignes, which you ſaw thereupon. And by the graduation you may ſee the latitude thereof, that thereby you may finde it, if at any time after you goe to ſeeke for it.

Chap. XXX.

Seeing two knowne points or Capes of land as you ſaile along, how you may know the diſtance of your ſhip from them.

IT is the cuſtome of paſſengers, when they firſt deſcrie that land which they would arriue at, to aske the Pilot how farre they are from land. Vnto which queſtion hee may well anſwere,

ſwere, if hee know two capes, or points, or notable places thereupon: which places the further they be aſunder one from another, the more certainly may he anſwere to that queſtion.

Let him pitch therefore one foote of one paire of compaſſes vpon one of the two foreſaid capes, and the other foote vpon the rumbe which in his compaſſe pointeth towards that cape. And in like manner ſhall he doe with another paire of compaſſes, placing one foot thereof vpon the other knowne cape, and the other foote vpon the rumbe which ſtretcheth towards the ſaid ſecond cape. And mouing the two compaſſes ſo opened by their two rumbs off from the land, the very ſame point where the two feete which came from the two capes doe meete, you may affirme to be the very point where your ſhip is. And then taking meaſure by the ſcale of leagues, you may ſee what diſtance there is from the ſaid point to either of the foreſaid capes, or to any other place, which you thinke good, for it is a very eaſie matter if you know the point where your ſhip is.

Chap. XXXI.

Of the account of the Moone.

THe account of the Moone and of the tides is moſt neceſſarie to bee knowne of mariners, to enter and depart from any hauens, riuers, or barres, and to paſſe by ſome bankes, and ſhoalds.

A tide is a regular motion of the ſea, whereby at ſome

ſome times it ſeemeth more increaſed then at other. And theſe tides are of two ſorts: for ſome are ſuch as we call ſpring-tides and neap-tides, and the courſe of this motion hapneth from one halfe moneth to another halfe moneth. Others be thoſe which wee call more properly by the names of tides, to wit, a full ſea, and a low ſea, a ſwelling and a falling ſea; and theſe are from the one halfe lunar day, to the other halfe. Which tides, as well the firſt as the ſecond, haue their courſe and mouing from the motion of the Moone: which is of two ſorts; one proper from weſt to eaſt, by meanes whereof in thirtie daies almoſt, it is in coniunction with the Sun, which we call the new moone; and in oppoſition, which wee call the full of the moone; and thoſe wee name the quarters, when it ſhineth halfe vnto vs. The other motion is from eaſt to weſt by the force of the *Primum mobile*, or the firſt moueable heauen, whereby in one lunar day the Moone paſſeth ouer all the two and thirtie points of the Compaſſe, or to ſpeak more plainly, it riſeth and ſetteth, and returneth againe to ariſe. Which two motions of the Moone being knowne, we may eaſily diſcerne the maner of both kindes of the foreſaid tides. And becauſe that to the knowledge hereof it is requiſite that wee know the middle motion of the Moone; I will firſt ſet downe how it may be knowne, and then how thereby wee may diſcerne the ſeaſons of the tides.

For which purpoſe, wee are to note that the golden number, as it is commonly called, is a certaine number of yeeres, wherein the Moone hath all the diuerſities of aſpects with the Sunne that can hap-

pen

pen betweene them, which is done in euery nineteene yeeres almoſt.

As for example, if in the yeere 1588 there be a coniunction of the Sunne and Moone vpon the 26 of April, or an oppoſition vpon the 11 of April, I ſay that there ſhal not happen a coniunction of the Sun and Moone vpon the 26 of April, nor an oppoſition vpon the 11 of April till 19 yeeres be expired, which will be in the yeere of our Lord 1607. And ſo are wee to conceiue likewiſe of the quarters and other aſpects.

The ſecond thing to be noted, is, that from this golden number ſpringeth another, which is called the concurrent, being the daies of the Moone at the beginning of the yeere: which yeere, according to that account, beginneth from the laſt of Februarie, about twelue a clock at night, which is the beginning of March. And the daies of the Moone which then remaine, beſides all the whole lunare moneths of the yeere paſt are called by Calculators *The concurrents*; becauſe they ſerue to know the account of the Moone, throughout the whole yeere that is to come; and they concurre with other numbers to know the age of the Moone. Now by theſe two numbers, to bee able to diſcerne the daies of the Moone, or the diſtance thereof from the Sunne, you are to note the rules following.

The firſt rule of the golden number.

From the preſent yeere of our Lord you muſt deduct 1500, and out of the remainder, taking one in euery

euery twentie, we ſhall finde the golden number, if they be iuſt twenties. But if they be not iuſt twenties; aboue the number of twenties wee muſt adde that which remaineth aboue the twenties: al which being added together, if it exceed not nineteene, ſhall be the golden number. But if it exceed nineteene, caſt away nineteene, and the remainder is the golden number.

The ſecond rule of the concurrent.

Diuide the golden number by three, and if there remaine one, the concurrent is equall with the golden number; and if there remaine two, the concurrent is greater then the golden number by ten: but if nothing remaine, the concurrent exceedeth the golden number by twentie. And if this concurrent exceed the number of thirtie, then the remainder or ſurpluſſage ſhall be the concurrent.

The third rule of the coniunction.

The number of the concurrent being knowne, you muſt adde it vnto the number of moneths, which haue paſſed from the beginning of March laſt paſt, till the end of that moneth wherein you would know the ſame: and if the whole product amounteth not to thirtie, marke how much it wanteth of thirtie: and if it exceedeth thirtie, ſee what it lacketh of ſixtie, and that which it wanteth either of thirtie or ſixtie, is the number of the daies of ſuch a moneth wherein the coniunction hapneth.

The

The fourth rule, of the full and quarters of the Moone.

If the day of the coniunction be before the 15 day of the moneth, adde 15 vnto the day of the coniunction, and you ſhall finde the day of the full Moone; and if the coniunction happen after the 15 day, take away 15 from the number of the day of the coniunction, and you ſhall haue the full Moone of that moneth.

The firſt quarter is ſeuen daies after the coniunction, and the laſt quarter ſeuen daies after the full Moone.

The fifth rule, of the ſpring-tides, and neap-tides.

Vpon the day of the coniunction, and of the full Moone, are the ſpring-tides, and vpon the two quarter daies are the neap-tides: and ſo much the more doe the waters increaſe, as the coniunction or full Moone are neerer: and ſo much the more they decreaſe alſo, the neerer they come vnto the quarters.

An example whereby the foreſaid rules are made more plaine.

Suppoſe a fleete of ſhips lie within the hauen of *San Lucar de barrameda*, expecting a fit time to paſſe ouer the barre towards the Indies. It is euident, that if the ſhips be great, they haue need of much water to paſſe the banke, or the barre: which quantitie of

water is only in the ſpring-tides. And becauſe they are twice in one moneth, namely in the coniunction and in the full of the Moone, I deſire to know when the ſpring-tides and neap-tides of the moneth of Iune in the yeere 1588 were to bee expected, in which moneth I preſuppoſe the fleete was to depart. Firſt therefore I caſt away 1500, and out of the 88 remaining I take from each 20, one, which make foure in all; which being added to the 8 that ſurmount 80, they make the golden number to be 12, according to the firſt rule. I diuide theſe twelue by three, and the quotient is foure, and nothing remaineth; and becauſe there is no remainder, I will take two more of the concurrent then of the golden number, and there ſhall be two of the concurrent, caſting away thirtie, by the ſecond rule. Adding theſe two to the foure moneths which are from the beginning of March paſt till this preſent moneth of Iune, I finde that they make ſixe. And becauſe ſixe want twentie foure to make vp thirtie, I ſay that in the yeere 1588 we had a coniunction of the Moone vpon the 24 of Iune, by the third rule, and adding ſeuen vnto the day of this coniunction, you haue the firſt of Iuly, which is the day of the firſt quarter. And taking away 15 from 24, being the number of the coniunction day, there remaine nine, and vpon that day of the moneth you haue the full Moone. And adding other ſeuen vnto the nine daies of the full Moone, you haue the laſt quarter vpon the ſixteenth of Iune by the fourth rule. I ſay therefore that the ſpring-tides or greateſt waters of the moneth of Iune, were in that yeere vpon the ninth, and foure

These daies mentioned in this example, are to be vnderſtood according to the new Romane Gregorian Kalendar, which goeth alwaies tenne daies before ours vſed in England.

foure and twentieth daies of Iune; and the neap-tides, or leſſe waters were vpon the ſixteenth day of Iune, and the firſt of Iuly by the fifth rule.

Chap. XXXII.
Of the daily Tides.

NOw that wee know the rules of the ſpring-tides and neap-tides, let vs ſay ſomewhat of the tides that happen euery day, which depend vpon another ſwift motion of the Moone, whereby turning round about the world from Eaſt to Weſt, it paſſeth euery day by the 32 points of the Compaſſe: and this daily motion of the ſea, falleth not euery day at the ſame houre, becauſe the Moon doth not alwaies keepe one and the ſame diſtance from the Sun. For the Moone moueth almoſt thirteene degrees of her proper motion in one naturall day, whereas the Sunne moueth ſcarce one: and ſo one being taken from thirteene, there remaine 12. And becauſe the Sun doth giue, and marke out vnto vs houres, and the Moone tides, it commeth to paſſe that an houre being that ſpace of time wherein fifteene degrees of the æquinoctiall paſſe by euery point of the Compaſſe, the part by which the Moon is diſtant from the Sunne ſhall be twelue degrees, which twelue are $\frac{4}{5}$ of fifteene degrees contained in each houre. Inſomuch that the Moone by her middle motion is euery day diſtant from the Sun about twelue degrees; which being reduced vnto time, doe make $\frac{4}{5}$ parts of an houre, whereby the Moone is euery day ſlower then the Sun, in comming to each

point of the heauens by the motion from East to West, in regard of that which she hath borrowed for her owne proper motion from West to East. Whereof it commeth to passe, that so many daies as the Moone is old, so many times $\frac{4}{5}$ parts of an houre is it slower then the Sun in passing by each rumbe, vntill the day of their coniunction, when as they passe both by the same rumbe, in one and the same houre. And so accordingly, because wee are to set downe the certaine houre of euery day wherein the tide happeneth, wee must diligently obserue the rules following.

The first rule.

In diuers parts of the sea coast, the Moone maketh a full sea euery day, being in diuers rumbes, according to the disposition of the land. But vpon all the coast of Spaine in the Ocean, it is full sea when the Moone is in the northeast and southwest.

The second rule.

Vpon the day of the coniunction and full moone, you haue a full sea at three a clock in the morning, and at three in the afternoone; for at those houres the Moone goeth with the Sun at the northeast and at the southwest. But vpon other daies of the moon, the full sea falleth out at the same houre when the Moone commeth to those two points; which is knowne by counting the age of the Moone.

The third rule.

That you may know at all times how many daies old the Moone is, you muſt adde three numbers together; to wit, the concurrent, and the moneths from the beginning of March to the moneth preſent, and the daies of the moneth wherein you would know this: and if the whole product exceedeth not thirtie, it containeth iuſt the daies of the Moone; but if it doth exceed thirtie, the ſurpluſſage ſheweth the daies of the Moones age.

The fourth rule.

Multiplie the daies of the Moones age by foure, and diuide the product by fiue, and the remainder after diuiſion containeth the houres whereby the Moone commeth more ſlowly then the Sunne, to the northeaſt or ſouthweſt, or to that rumbe wherein it maketh a full ſea: which houres ſhall be added to the three houres of the morning, and then you haue the houres of the firſt tide or of the full and ſwelling ſea; and ſix houres and almoſt a quarter after, commeth the firſt ebbe, or low water, and 12 houres and $\frac{2}{5}$ after the firſt full ſea, commeth the ſecond tide: and other ſix houres and $\frac{1}{5}$ after the ſecond tide, commeth the ſecond ebbe.

The fifth rule.

When the daies of the Moones age are leſſe then fifteene, we may make by them our account for the

tides: but if they exceed fifteene, we muſt make our account by the ſurpluſſage.

An example of the ſaid rules.

Vpon the 29 of Iuly 1588, I deſired to know the houres of the full ſea and of the ebbe; to make choice of that which might ſeeme moſt expedient for my voyage. By the former example I finde that the golden number of this yeere is 12, and the concurrent 2, according to the correction of the yeere by Pope *Gregorie* the 13. Then I adde this number of 2 to the number of 5 moneths, which haue paſſed from the beginning of March, and the 29 daies of the moneth of Iuly, all which 3 numbers make 36; then I caſt away 30, and there remaine ſix daies for the age of the Moone: and becauſe they exceed not fifteene, I multiply them by $\frac{4}{5}$ of an houre, according to the fourth rule, and they make $\frac{24}{5}$. I diuide theſe 24 by 5, and I finde the quotient to be foure, and the remainder foure. And ſo I ſay that ỹ Moone commeth to the northeaſt foure houres and $\frac{4}{5}$ later then the Sunne. And becauſe the Sunne commeth to the northeaſt at three a clock in the morning, I adde thoſe foure houres and $\frac{4}{5}$ vnto the three houres laſt mentioned, and they make ſeuen houres and $\frac{4}{5}$, which is the houre of the morning wherein the tide or full ſea happeneth. And adding vnto theſe ſeuen houres and $\frac{4}{5}$ other ſix houres and $\frac{1}{5}$, they make in all foureteene houres, which falleth out at two a clock in the afternoone, which is the houre of the firſt low water or ebbe. And adding vnto the ſaid houre of the full ſea twelue houres and $\frac{2}{5}$, it will amount vnto

eight

eight of the clock and $\frac{1}{5}$ part of an houre, which is the houre of the night wherein the ſecond tide or high water was. And adde vnto this ſecond tide other ſix houres and $\frac{1}{5}$, and they make two of the clocke in the morning and $\frac{2}{5}$, at which time there commeth the ſecond ebbe or low ſea.

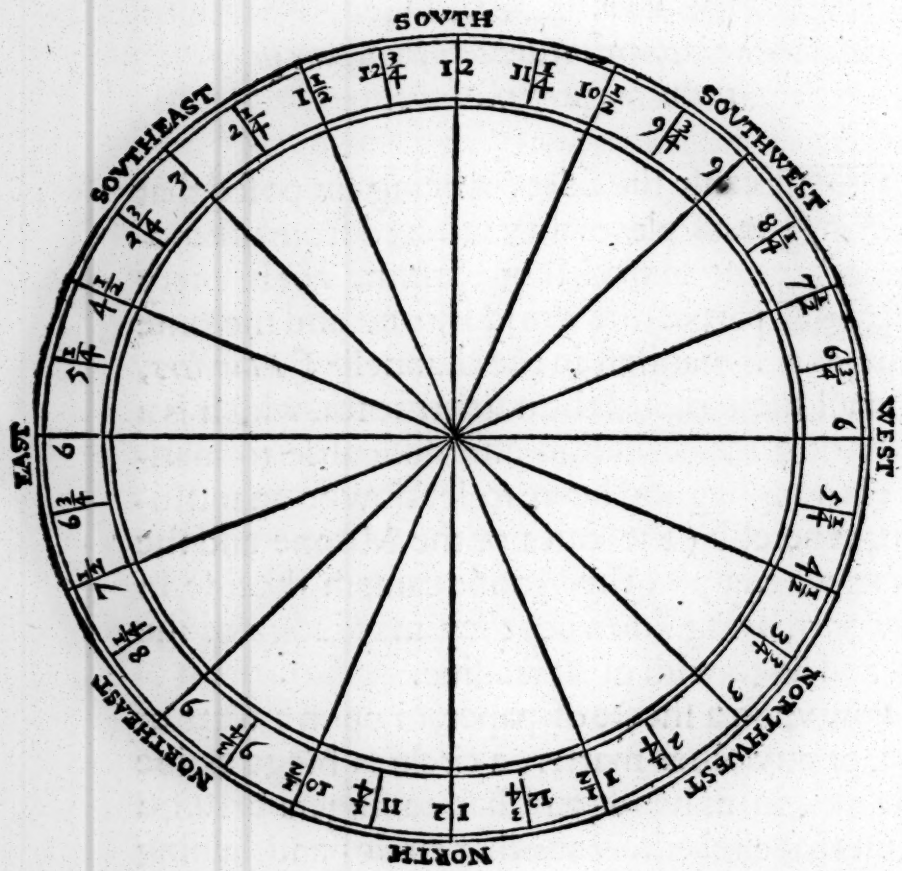
CHAP. XXXIII.

Of a certaine inſtrument, whereby you may in generall iudge of the tides.

BEcauſe the tides (it being ſuppoſed that in all places they proceed from the motion of the Moone) runne not in euery part of the world by one and the ſame rumbe, as it is manifeſt in the channell of *Flanders*, and in all the coaſts of the northerne ſea, which is a matter of great confuſion and difficultie to mariners: I thought good heere to ſet downe an inſtrument, whereby (the daies of the Moone and the rumbe, whereupon the Moone cauſeth the tide in euery part, being knowne) they may iudge of the ebbe and flood with great facilitie.

Draw vpon a ſheete of paper, or vpon a plate of tinne, or any other matter, a circle as bigge as the palme of a mans hand; and halfe a fingers breadth within that circle draw another circle; and hauing diuided them both into 32 equall parts, with lines drawne from the center to the circumference of the greater circle, vpon the vpper end of one of thoſe lines, place a flower de-lis, and the number of 12, and in the next line thereunto toward the left hand, ſet

downe 12 and ¾, and in the third line 1 ½, and ſo proceed forwards, putting downe vpon euery line following ¾ of an houre more, vntill you come againe to the number of 12 in the loweſt line. And from thence forwards ſet downe the ſame numbers that you did at the firſt.



Theſe 32 lines ſo drawne, doe repreſent the 32 windes, whereby the Sunne and Moone paſſe euery day. And ſo you may ſet downe the names of the principall windes, to the end that you may know them,

them, and thoſe that are next them. And then in like manner make another round and ſlender table, as bigge as the innermoſt circle of thoſe two which you drew in the firſt table: and diuiding it into thirtie equall parts, firſt into two by a line, diuiding it in the midſt, and then either of thoſe two into three, and euery of thoſe three into fiue, theſe diuiſions will repreſent the daies of the Moone. And leauing vpon 1 of thoſe parts an index or ſmall point, which may reach without the circle, ſet downe the numbers thereof, beginning with 30 in that part where that point endeth, and the number of 1 in the line following towards the left hand, and then 2, &c. till you end at the ſame point with 30. This being done, faſten with a threed or naile, the ſecond table or circle vpon the center of the firſt, ſo that it may freely without impediment turne round about.

The vſe of this Inſtrument.

The vſe of this inſtrument is, that knowing in euery port or part of any coaſt, the rumbe or quarter on which the Moone maketh full ſea, or high water, you muſt note vpon the outward circle of the windes that quarter or rumbe: and placing the tooth or point of the inner circle where the number of 30 is vpon that quarter or rumbe; make it there faſt, putting a little wax vnderneath, that it may not moue. Then account the daies of the Moones age in the inner circle, and ouer againſt the end of your account you ſhall ſee in the vttermoſt circle the houre of the full ſea of that day, together with the rumbe where the Sunne is at that houre. And at the

ſame houre when it is in the contrarie part, it will make a full ſea. The place of the Moone at the houre of the tide, is alwaies either where the point is, or at the point right ouer againſt it, and hence you may eaſily finde both ebbes alſo. This little inſtrument, although it be but of ſmall inuention, is of great vſe and profit for the nauigations of *Flanders, France, England, Ireland,* and all the northerne regions, where you haue much varietie in the tides.

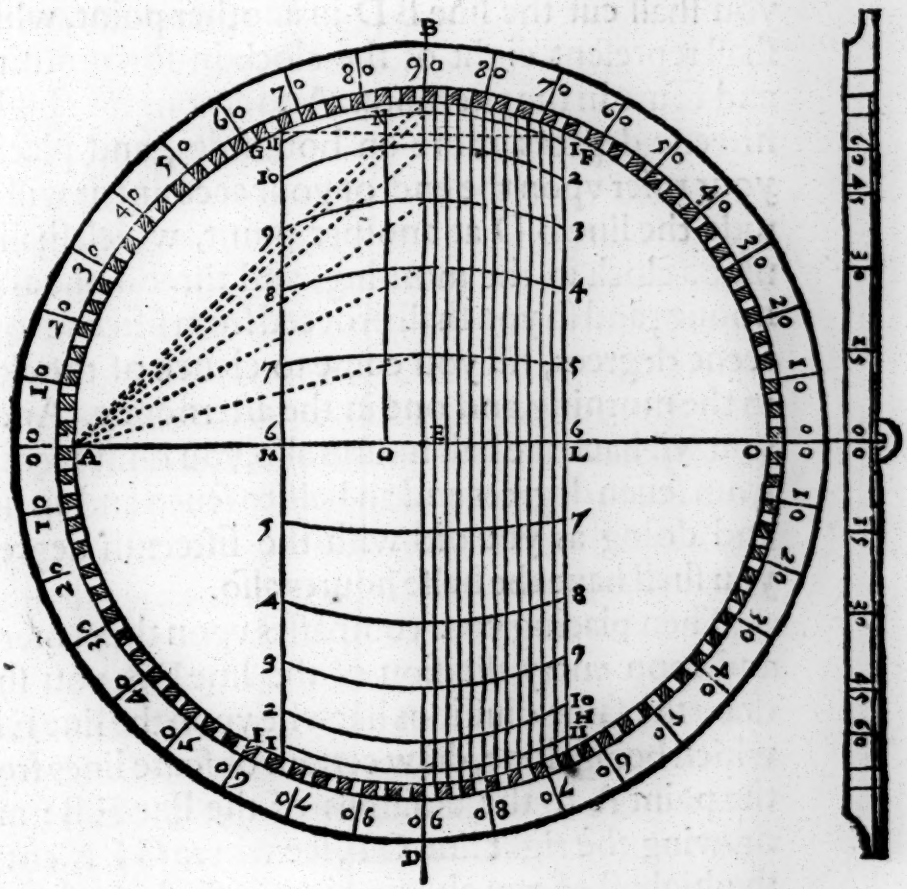
Chap. XXXIIII.

Of the making of an vniuerſall Diall, which may ſerue generally all the world ouer.

DRaw vpon a table or paſtboord the circle A B C D vpon the center E: and halfe a fingers breadth within that circle, vpon the ſame center draw another circle: and about the breadth of a wheate corne within the ſecond circle, draw a third; and placing your ruler vpon the center E, by the right line A C diuide the two inner circles in the midſt A B C, and C D A in the points B D, vpon which, and vpon the center E the ruler being placed, you may draw the line B D, whereby euery one of the foreſaid circles ſhall be diuided into foure equall parts. And diuiding euery one of thoſe foure quadrants of the inner circle, to wit, AB, BC, CD, DA into 90 parts (as the manner is in the making of an Aſtrolabe) ſet numbers thereto from 5 to 5, beginning your account from the two points A C, and ſo proceeding both waies till you end your account in 90, at the points B D; and

and this inner circle thus diuided, repreſenteth the meridian.

And the point C is the north, A the ſouth, and the points B D are thoſe where the æquinoctial cutteth the meridian. Then count 23 degrees and an halfe from the point B to F, and to G on both ſides. And ſo much account alſo from the point D to H and to I. And then drawing two right lines FH and G I, the line F H ſhall repreſent the tropick of *Cancer*, and G I the tropick of *Capricorne*. And thoſe two



lines

lines ſhall cut the line C A, (which is the axtree of the world, and the circle of ſix of the clock in the morning and euening) vpon the points L M. Then count fifteene degrees from C towards B, and other fifteene from A towards B, and placing your ruler on either ſide vpon the end of your account, you ſhall cut the æquinoctial B D vpon a certaine point, which ſhall repreſent vnto you ſeuen a clock in the morning, and fiue of the clock at euening. And counting other fifteene degrees on both ſides, more towards the point B, and placing the ruler as before, you ſhall cut the line B D in another point, which ſhall repreſent eight of the clock in the morning, and foure in the afternoon. And accounting higher fifteene degrees more on both ſides, and placing your ruler vpon the end of your account, it will diuide the line B D at another point, which ſhall be nine a clock in the morning, and three in the afternoone; and ſo you ſhall proceed from fifteene to fifteene degrees, till you come to eleuen of the clock in the morning, and one in the afternoone. And if you wil haue the half houres alſo, you muſt account from ſeuen degrees and an half, to ſeuen and an half; and doing as you did with the fifteenth degrees, you ſhall haue the halfe houres alſo.

Then placing your compaſſes vpon the center E, and vpon euery diuiſion of the line E B, you ſhall draw the ſame diuiſions likewiſe vpon the line E D; which being done, draw certain obſcure lines from the point A to the diuiſions of the line E B: and drawing the right line G F, ſee where G F is cut at the higheſt of the obſcure lines, which muſt be at the

the point N, from whence the line N O is to bee drawne equally diſtant from the line B E. And this line N O ſhall be diuided proportionally by the obſcure lines, euen as the line B E. Then let the diuiſions of the line N O be transferred into the lines M G, M I, L F, L H, and then the tropicks alſo ſhall be diuided. Then by euery three points anſwerable in the æquinoctiall, and the two tropicks, you ſhall draw certaine parts of circles, ſeeking the center of thoſe three points in the æquinoctiall line extended foorth on either ſide; and theſe parts of circles repreſent the houres: then make an account of the degr. of declination from the point B, and from D on both ſides by euery 2 degr. and draw lines parallel to the æquinoctiall from one to another; and thoſe ſhall be the parallels of the Suns declination. Moreouer, you ſhall make an horizon as large as the diameter of the inner circle, which ſhall be diuided after this manner: Count from the points A C towards B fiue degrees; and putting your ruler vpon the end of the account of both parts, ſee where it cutteth the line E B, and there make a marke: and then counting on both ſides other fiue degrees, and putting the ruler once againe at the end of your account, make another mark where it cutteth the line E B. And ſo the line E B muſt be diuided from fiue to fiue degrees; which diuiſions ſhall be remoued into the ſaid horizon, faſtning it to the center, and laying it to the line B D, and diuiding it both waies as the line E B is diuided; and ſet numbers thereinto from 5 to 5, which may begin in the midſt, and end with 90 at the ends of the Horizon, and let euerie

rie one of these parts be diuided into fiue other parts or degrees. Then accounting from the center E in the Horizon eleuen degrees and ¼, you shall set there a mark, which shall be the seuenth point from north and South, that is, it shall represent the points which are next to the East and West in the Compasse. And accounting other eleuen degrees and a quarter, and making there a marke, it shall represent the sixth point from North and South. And so you must doe with the other points, and then your instrument is finished.

Chap. XXXV.

Of the parts of this instrument.

IN this instrument, the first thing is a circle diuided into 360 degrees, which is the meridian and the line of twelue a clock. The second are the right lines, of which that in the midst is the æquinoctiall, and the two others are the tropicks of *Cancer* and *Capricorne*. And the other lines betweene those, are the parallels of the Suns declination, which haue their numbers agreeable to them. And those that are betweene the æquinoctiall, and the tropick of *Cancer*, doe serue from the 11 of March to the 13 of September, and the others for the residue of the yeere. The crooked lines which crosse those parallels are the houre lines. And the point of the meridian, which is 90 degrees distant from the æquinoctiall, towards the left hand, is the north pole: and the point opposite to that, is the south pole. In the Horizon there are first the degrees, and then the points of

of the Compaſſe diſtinguiſhed by the ſmall pricked lines.

Chap. XXXVI.

How you may know what a clock it is by this Inſtrument.

AT any time of the day, when you would know what a clock it is, take ỹ heigth of the Sun with your Aſtrolable, and ſeek in the table of the Sunnes declination, what declination it hath the ſame day, & the height of the pole, which a good mariner knoweth at all times, becauſe hee muſt direct his courſe thereby. This being knowne, place the horizon of the inſtrument on the one ſide vnder the north, and on the other ſide aboue the ſouth, ſo many degrees as his diſtance from the æquinoctiall is the ſame day: and faſtē it there with a little wax that it may not moue. Then count in the meridian on either ſide from the horizon (which now ſtandeth firme) the height of the Sunne aboue the horizon, taken with your Aſtrolabe: and by the end of the account, draw a line or threed ouerthwart, which ſhall be equally diſtant from the horizon. Then reckon the Suns declination in the parallels, beginning from the æquinoctiall of the inſtrument that way which the Sun declineth, and marke the line or parallel, at which the account of the declination endeth; where and at what houre it is croſſed by the threed, for that houre is the houre of the day. But note this, that if the croſſing of the threed and parallel doe fall vpon the

the diuiſion of the parallel and of the houre, it is a iuſt houre; but if it fall beſide the common meeting of the parallel and of the houre-line vpon that ſide where it falleth, ſee how much more there is then an houre, whether $\frac{1}{4}$, or $\frac{1}{3}$, or $\frac{1}{2}$, &c. Now although euery houre line hath two numbers, one of the morning and another of the afternoone, yet it is an eaſie matter to diſtinguiſh which of them will ſerue your turne, if you know whether your obſeruation be before high noone or after; which is to bee knowne by your Aſtrolabe: for if the Sun aſcend, it is before noone; but if it deſcend, it is afternoon.

Chap. XXXVII.

Of the variation of the Compaſſe, by this inſtrument.

IF you would know by this inſtrument the variation of the Compaſſe, you muſt doe thus: When the Sunne riſeth or goeth downe at the horizon, obſerue him with your compaſſe, noting very diligently vpon what rumbe and part of the rumbe he riſeth or falleth. And if the compaſſe be diuided into 360 parts, beginning to reckon them from the Eaſt and from the Weſt on either ſide, and ending in the North and South with 90 degrees, it ſhall be the fitter for this purpoſe, becauſe then you ſhall ſee the very degree of the compaſſe vpon which the Sunne riſeth or ſetteth. Then the horizon being ſet faſt (as wee haue ſhewed in the former chapter) marke in the inſtrument by which part or degree of thoſe vpon the

the horizon, the parallel of the Sunnes declination that day doth croſſe the ſame: counting in the numbers of the horizon from the center towards the North pole, if it be from the 11 of March to the 13 of September; or towards the South pole, the other halfe of the yeere: And marke alſo whether this croſſing be ſo many degrees diſtant from the diuiſion of the æquinoctiall of your inſtrument, as the Sunne in his riſing was diſtant from the eaſt of the Compaſſe, or at his going downe was diſtant from the weſt thereof; for then you may ſay that the Compaſſe hath no variation at all. But if it be not ſo, marke the rules following:

1 When the Sunne riſeth by the ſame rumbe of the Compaſſe which the inſtrument doth ſhew, the Compaſſe hath no variation at all.

2 When the Sunne riſeth more to the North of the Compaſſe, or goeth downe more to the South, then is ſhewed by the inſtrument, all the difference betweene the inſtrument and the Compaſſe is the northeaſting, or variation thereof to the eaſtward.

3 If the Sunne riſeth more to the South of the Compaſſe, or ſetteth more to the North then the inſtrument ſheweth, all the difference betweene the inſtrument and the Compaſſe is the northweſting, or weſterly variation thereof.

Chap. XXXVIII.

At what houre the Sunne riſeth and ſetteth euery day, in all parts of the world.

THe height of the pole in that part where you deſire to know this; being knowne, place the Horizon

Horizon in such sort as was shewed in the 36 chapter. And finding by the table of the Sunnes declinations the declination which the Sunne hath that day, count the same from the æquinoctial of the instrument towards that part whither the Sunne declineth among the parallels, and then marke the parallel whereat your account endeth, in what houre, and in what part of the houre it cutteth the Horizon; noting that euery houre hath two numbers, one afternoone, which is the houre of the Suns setting; and another before noone, which is that wherin the Sunne riseth.

Chap. XXXIX.

Of the length of the day and of the night.

THe houre of the Suns going downe being knowne, double it, and the double number of houres will shew you the length of the day. Also the houre of the Sunnes rising being knowne, and doubled, will manifest vnto you the length of the night, in that part of the yeere when you desire to know the same.

Chap. XL.

Of a night-diall by the North.

THat being knowne which is before declared of the situation of the North starre and of the guards, wee may easily know in the night what a clock it is, whersoeuer wee can see the north

north ſtarres: preſuppoſing that vpon the 15 of Aprill at the very point of midnight, the former guard goeth a-head in reſpect of the north ſtarre. And becauſe by this account of the houre of the night, wee muſt take for a beginning, the very inſtant when the former guard maketh midnight; the rule following is to be obſerued.

The rule.

The number of the whole moneths which haue paſſed ſince the 15 of April forward being doubled, you haue the number of the houre wherein the former guard maketh midnight, being head-moſt: and if the moneths fall not out iuſt, adde for euery fifteene daies, aboue the whole moneths, one day, and for euery day foure minutes, and you ſhall know when it is midnight.

As for example.

If I would know vpon the 15 of Nouember, where the former guard maketh midnight, I account the whole moneths from the 15 of April, and I finde them to be ſeuen: which being doubled, make foureteene. I ſay therefore, that vpon the 15 of Nouember, it ſhall be midnight, when the former guard hath paſſed before the north or head foureteene houres. And ſo allowing three to the northweſt, three to the weſt, and ſix to the foote, it may be ſaid that the former guard going two houres before the foote towards the ſouthweſt, that it is midnight, which ſhall come to paſſe when the former guard goeth an houre before from the ſouthweſt. This be-

ing thus preſuppoſed, when I would know in the night what a clock it is, I muſt note two things: the one is, in what part the former guard maketh midnight the ſame night. The ſecond is, in what part the ſaid guard is at the ſame inſtant, when I would know the time of the night; which being vnderſtood, I will make mine account from that which the guard wanteth of being come to the place where that day it maketh midnight; or from ſo much as it hath paſſed the ſame place, making mine account that one third part of foure points of the Compaſſe is an houre, and that which it wanteth of being come, or which it hath paſſed forward, are the houres before midnight, if it be not come to the place; or after midnight, if it haue gone beyond.

As for example.

I ſee the former guard in the northweſt vpon the 15 of Iuly; becauſe that vpon the 15 of Iuly, by the account before mentioned, the former guard maketh midnight in the weſt: and from the north or head to the weſt, are ſix houres; and from the northweſt, where I ſaw the guard, to the weſt, where it maketh midnight, are three houres: I ſay therefore that it is three houres before midnight; that is to ſay, nine of the clock at night.

FINIS.

BEcauſe the tables of the Sunnes declination that haue bin moſt in vſe amongſt Engliſh ſea men, doe both in faſhion and manner of vſing ſomething differ from thoſe before ſet downe, pag. 393, 394, &c. Leſt any therefore of the meaner ſort might be miſtaken, or ſhould not rightly conceiue the manner of vſing theſe tables; I thought good to adioyne theſe alſo heere following, bearing in a manner the ſame forme and ſhape, and therefore alſo to be vſed altogether almoſt in the ſame ſort that thoſe tables haue been, which for theſe many yeeres haue been moſt vſed by Engliſh mariners.

This table of the Sunnes declination containeth twelue particular tables, ſhewing the declinations of the Sunne for euery day of the twelue moneths of the yeere for foure yeeres together, from leap yeere to leape yeere. In the head of euery one of theſe tables is firſt ſet downe the moneth for which that table is made. Vnder this are placed the yeeres of our Lord, for which thoſe tables may ſerue: which yeeres are diuided into foure rankes, ſignified by the foure arithmeticall characters 1, 2, 3, 4, that are ſet ouer them. The firſt ranke containeth the firſt yeeres immediatly following after the leape yeere: the next ranke containeth the ſecond yeeres after the leape yeere. In the third ranke are ſet downe the yeeres that follow three yeeres after the leap yeere: and in the fourth and laſt rank are the fourth yeeres after the precedent leap yeeres, which are alſo leap-yeeres themſelues.

Vnder euery one of theſe rankes of yeeres there

are two columnes; the first whereof containeth the degrees and min. of the Sunnes declination, answerable to euery day of the moneth, superscribed in each of those yeeres, without sensible error. In the second columne are set downe the minutes of the differences of the Suns declinations for euery one of those daies, for the readier finding of the part proportionall of this difference, answering to any difference of longitude from London, whereof you may reade more pag. 423, &c. In the first columne of each of these tables next the left hand are placed the numbers of the daies of the moneth that is set downe in the head thereof. The vse of this table for knowing the declination of the Sunne at any time is thus: Looke the moneth and yeere wherein you would know the same in the head of the table, and the day of the moneth in the first columne next the left hand; then proceeding from that day directly in the same line towards the right hand, till you come right vnder the same yeere, you shall there finde the declination you sought for.

The vse of this table.

Take for example the 24 day of February in the yeere 1610. Finding therefore that moneth and yeere in the head of the table, and the 24 day in the first columne; in the same line proceeding towards the right hand, till you come right vnder that yeere, you haue there the Sunnes declination for that time 5 degrees, 34 minutes towards the South.

Ianuary.

	1			2			3			4		
	1609 1613 1617			1610 1614 1618			1611 1615 1619			1612 1616 1620		
Day.	De.	Mi.	dif.	De.	Mi.	dif.	De.	Mi.	dif.	De.	Mi.	dif.
1	21	47	10	21	50	10	21	52	10	21	54	9
2	21	37	10	21	40	10	21	42	10	21	45	10
3	21	27	10	21	30	11	21	32	10	21	35	11
4	21	17	11	21	19	11	21	22	11	21	24	11
5	21	6	12	21	8	11	21	11	11	21	13	11
6	20	54	12	20	57	12	21	0	12	21	2	11
7	20	42	12	20	45	12	20	48	12	20	51	12
8	20	30	13	20	33	13	20	36	13	20	39	13
9	20	17	13	20	20	13	20	23	13	20	26	13
10	20	4	14	20	7	13	20	10	13	20	13	13
11	19	50	14	19	54	14	19	57	14	20	0	13
12	19	36	14	19	40	14	19	43	14	19	47	14
13	19	22	14	19	26	15	19	29	14	19	33	15
14	19	8	15	19	11	15	19	15	15	19	18	14
15	18	53	15	18	56	15	19	0	15	19	4	15
16	18	38	16	18	41	15	18	45	15	18	49	16
17	18	22	16	18	26	16	18	30	16	18	33	15
18	18	6	16	18	10	16	18	14	16	18	18	16
19	17	50	17	17	54	17	17	58	17	18	2	17
20	17	33	17	17	37	16	17	41	16	17	45	16
21	17	16	17	17	21	17	17	25	17	17	29	17
22	16	59	17	17	4	18	17	8	18	17	12	17
23	16	42	18	16	46	17	16	50	17	16	55	18
24	16	24	18	16	29	18	16	33	18	16	37	18
25	16	6	18	16	11	19	16	15	18	16	19	18
26	15	48	19	15	52	18	15	57	19	16	1	18
27	15	29	19	15	34	19	15	38	18	15	43	19
28	15	10	19	15	15	19	15	20	19	15	24	19
29	14	51	19	14	56	19	15	1	20	15	5	19
30	14	32	19	14	37	20	14	41	19	14	46	19
31	14	13		14	17		14	22		14	27	

South declination.

South declination.

February.

South declination.

Day.	1			2			3			4		
	1609 1613 1617			1610 1614 1618			1611 1615 1619			1612 1616 1620		
	De.	Mi.	dif.	De.	Mi.	dif.	De.	Mi.	dif.	De.	Mi.	dif.
1	13	53	20	13	58	20	14	2	20	14	7	20
2	13	33	21	13	38	21	13	42	20	13	47	20
3	13	12	20	13	17	20	13	22	20	13	27	21
4	12	52	21	12	57	21	13	2	21	13	6	20
5	12	31	21	12	36	20	12	41	20	12	46	20
6	12	10	21	12	16	21	12	21	21	12	26	21
7	11	49	21	11	55	22	12	0	22	12	5	21
8	11	28	21	11	33	21	11	38	21	11	44	22
9	11	7	22	11	12	22	11	17	21	11	22	21
10	10	45	22	10	50	22	10	56	22	11	1	22
11	10	23	22	10	28	21	10	34	22	10	39	22
12	10	1	22	10	7	22	10	12	22	10	17	22
13	9	39	22	9	45	22	9	50	22	9	55	22
14	9	17	22	9	23	23	9	28	22	9	33	22
15	8	55	23	9	0	22	9	6	22	9	11	22
16	8	32	22	8	38	23	8	43	23	8	49	23
17	8	10	23	8	15	22	8	21	22	8	26	22
18	7	47	23	7	53	23	7	58	23	8	4	23
19	7	24	23	7	30	23	7	35	23	7	41	23
20	7	1	23	7	7	23	7	12	23	7	18	23
21	6	38	23	6	44	23	6	49	23	6	55	23
22	6	15	23	6	21	23	6	26	23	6	32	23
23	5	52	23	5	58	23	6	3	23	6	9	23
24	5	29	24	5	34	24	5	40	23	5	46	23
25	5	5	23	5	11	23	5	17	23	5	22	24
26	4	42	24	4	48	23	4	53	24	4	59	23
27	4	18	23	4	24	24	4	30	23	4	36	23
28	3	55		4	1	23	4	6	24	4	12	24
29										3	49	23

South declination.

March.

	1			2			3			4		
	1609 1613 1617			1610 1614 1618			1611 1615 1619			1612 1616 1620		
Day.	*De.*	*Mi.*	*dif.*	*De.*	*Mi.*	*dif.*	*De.*	*Mi.*	*dif.*	*De.*	*Mi.*	*dif.*
1	3	31	23	3	37	24	3	43	24	3	23	24
2	3	8	24	3	13	23	3	19	23	3	1	24
3	2	44	24	2	50	24	2	56	24	2	37	23
4	2	20	23	2	26	23	2	32	24	2	14	24
5	1	57	24	2	3	24	2	8	23	1	50	23
6	1	33	24	1	39	24	1	45	24	1	27	24
7	1	9	23	1	15	24	1	21	24	1	3	24
8	0	46	24	0	51	23	0	57	24	0	39	24
9	0	22	24	0	28	24	0	33	23	0	15	23
10	0	2	23	0	4	24	0	10	24	0	8	24
11	0	25	24	0	20	23	0	14	24	0	32	24
12	0	49	24	0	43	24	0	38	23	0	56	23
13	1	13	23	1	7	24	1	1	24	1	19	24
14	1	36	24	1	31	23	1	25	24	1	43	23
15	2	0	24	1	54	24	1	49	23	2	6	24
16	2	24	23	2	18	23	2	12	24	2	30	23
17	2	47	23	2	41	24	2	36	23	2	53	24
18	3	10	24	3	5	23	2	59	23	3	17	23
19	3	34	23	3	28	23	3	22	24	3	40	23
20	3	57	23	3	51	24	3	46	23	4	3	24
21	4	20	23	4	15	23	4	9	23	4	27	23
22	4	43	23	4	38	23	4	32	23	4	50	23
23	5	6	23	5	1	23	4	55	23	5	13	23
24	5	29	23	5	24	23	5	18	23	5	36	23
25	5	52	23	5	47	23	5	41	23	5	59	22
26	6	15	23	6	10	22	6	4	23	6	21	23
27	6	38	22	6	32	23	6	27	22	6	44	22
28	7	0	23	6	55	22	6	49	23	7	6	23
29	7	23	22	7	17	23	7	12	22	7	29	22
30	7	45	22	7	40	22	7	34	22	7	51	22
31	8	7		8	2		7	56		8	13	

South declination. *North declination.* *South declination.* Æquinoctiall. *North declination.*

Aprill.

Day.	1			2			3			4		
	1609 1613 1617			1610 1614 1618			1611 1615 1619			1612 1616 1620		
	De.	Mi.	dif.	De.	Mi.	dif.	De.	Mi.	dif.	De.	Mi.	dif.
1	8	29	22	8	24	22	8	18	22	8	35	22
2	8	51	22	8	46	22	8	40	22	8	57	22
3	9	13	21	9	8	21	9	2	22	9	19	21
4	9	34	22	9	29	22	9	24	22	9	40	22
5	9	56	21	9	51	21	9	46	21	10	2	21
6	10	17	21	10	12	21	10	7	21	10	23	21
7	10	38	21	10	33	21	10	28	21	10	44	21
8	10	59	21	10	54	21	10	49	21	11	5	21
9	11	20	21	11	15	21	11	10	21	11	26	20
10	11	41	20	11	36	20	11	31	20	11	46	20
11	12	1	20	11	56	20	11	51	20	12	6	20
12	12	21	20	12	16	20	12	11	20	12	26	20
13	12	41	20	12	36	20	12	31	20	12	46	20
14	13	1	19	12	56	20	12	51	19	13	6	20
15	13	20	20	13	16	19	13	10	20	13	26	19
16	13	40	19	13	35	19	13	30	20	13	45	19
17	13	59	19	13	54	19	13	50	19	14	4	19
18	14	18	18	14	13	19	14	9	18	14	23	18
19	14	36	19	14	32	18	14	27	19	14	41	19
20	14	55	18	14	50	19	14	46	18	15	0	18
21	15	13	18	15	9	18	15	4	18	15	18	18
22	15	31	18	15	27	17	15	22	18	15	36	17
23	15	49	17	15	44	18	15	40	18	15	53	18
24	16	6	17	16	2	17	15	58	17	16	11	17
25	16	23	17	16	19	17	16	15	17	16	28	17
26	16	40	17	16	36	17	16	32	17	16	45	16
27	16	57	16	16	53	16	16	49	16	17	1	16
28	17	13	16	17	9	16	17	5	16	17	17	16
29	17	29	16	17	25	16	17	21	16	17	33	16
30	17	45		17	41		17	37		17	49	

North declination.

North declination.

May.

North declination.

Day.	1			2			3			4		
	1609 1613 1617			1610 1614 1618			1611 1615 1619			1612 1616 1620		
	De.	Mi.	dif.	De.	Mi.	dif.	De.	Mi.	dif.	De.	Mi.	dif.
1	18	0	15	17	57	15	17	53	15	18	4	15
2	18	15	15	18	12	15	18	8	15	18	19	15
3	18	30	15	18	27	14	18	23	15	18	34	15
4	18	45	14	18	41	15	18	38	14	18	49	14
5	18	59	14	18	56	14	18	52	14	19	3	14
6	19	13	14	19	10	13	19	6	14	19	17	13
7	19	27	13	19	23	14	19	20	14	19	30	13
8	19	40	13	19	37	13	19	34	13	19	43	13
9	19	53	12	19	50	12	19	47	12	19	56	13
10	20	5	13	20	2	13	19	59	13	20	9	12
11	20	18	12	20	15	12	20	12	12	20	21	12
12	20	30	11	20	27	11	20	24	12	20	33	11
13	20	41	11	20	38	12	20	36	11	20	44	11
14	20	52	11	20	50	11	20	47	11	20	55	11
15	21	3	11	21	1	10	20	58	11	21	6	11
16	21	14	10	21	11	11	21	9	10	21	17	10
17	21	24	10	21	22	10	21	19	10	21	27	9
18	21	34	9	21	32	9	21	29	10	21	36	10
19	21	43	9	21	41	9	21	39	9	21	46	9
20	21	52	9	21	50	9	21	48	9	21	55	8
21	22	1	8	21	59	8	21	57	8	22	3	8
22	22	9	8	22	7	8	22	5	8	22	11	8
23	22	17	8	22	15	8	22	13	8	22	19	8
24	22	25	7	22	23	7	22	21	7	22	27	7
25	22	32	6	22	30	7	22	28	7	22	34	6
26	22	38	7	22	37	6	22	35	7	22	40	6
27	22	45	6	22	43	6	22	42	6	22	46	6
28	22	51	5	22	49	6	22	48	6	22	52	6
29	22	56	5	22	55	5	22	54	5	22	58	5
30	23	1	5	23	0	5	22	59	5	23	3	5
31	23	6		23	5		23	4		23	8	

North declination.

Iune.

North declination.

Day.	1			2			3			4		
	1609 1613 1617			1610 1614 1618			1611 1615 1619			1612 1616 1620		
	De.	Mi.	dif.	De.	Mi.	dif.	De.	Mi.	dif.	De.	Mi.	dif.
1	23	10	4	23	10	4	23	8	4	23	12	4
2	23	14	4	23	14	3	23	12	4	23	16	3
3	23	18	3	23	17	3	23	16	4	23	19	3
4	23	21	3	23	20	3	23	20	3	23	22	3
5	23	24	2	23	23	3	23	23	2	23	25	2
6	23	26	2	23	26	2	23	25	2	23	27	2
7	23	28	2	23	28	1	23	27	2	23	29	1
8	23	30	1	23	29	1	23	29	1	23	30	1
9	23	31	0	23	30	1	23	30	1	23	31	0
10	23	31	0	23	31	0	23	31	0	23	31	0
11	23	31	0	23	31	0	23	31	0	23	31	1
12	23	31	1	23	31	1	23	31	1	23	30	1
13	23	31	1	23	30	1	23	30	1	23	29	1
14	23	30	2	23	29	2	23	29	2	23	28	2
15	23	28	2	23	27	2	23	27	2	23	26	2
16	23	26	2	23	25	3	23	25	2	23	24	3
17	23	24	3	23	22	3	23	23	3	23	21	3
18	23	21	3	23	19	3	23	20	3	23	18	4
19	23	18	3	23	16	4	23	17	4	23	14	4
20	23	15	4	23	12	4	23	13	4	23	10	4
21	23	11	4	23	8	4	23	9	4	23	6	5
22	23	7	5	23	4	5	23	5	5	23	1	5
23	23	2	5	22	59	6	23	0	5	22	56	6
24	22	57	5	22	53	5	22	55	6	22	50	6
25	22	52	6	22	48	7	22	49	6	22	44	6
26	22	46	6	22	41	6	22	43	7	22	38	7
27	22	40	7	22	35	7	22	36	7	22	31	7
28	22	33	7	22	28	7	22	29	7	22	24	7
29	22	26	7	22	21		22	22		22	17	
30	22	19										

North declination.

July.

North declination.

Day.	1			2			3			4		
	1609 1613 1617			1610 1614 1618			1611 1615 1619			1612 1616 1620		
	De.	Mi.	dif.	De.	Mi.	dif.	De.	Mi.	dif.	De.	Mi.	dif.
1	22	11	8	22	13	8	22	15	8	22	9	9
2	22	3	9	22	5	9	22	7	9	22	0	8
3	21	54	9	21	56	9	21	58	8	21	52	9
4	21	45	9	21	47	9	21	50	9	21	43	10
5	21	36	10	21	38	9	21	41	10	21	33	9
6	21	26	10	21	29	10	21	31	10	21	24	11
7	21	16	10	21	19	11	21	21	10	21	13	10
8	21	6	11	21	8	10	21	11	11	21	3	11
9	20	55	11	20	58	11	21	0	11	20	52	11
10	20	44	11	20	47	12	20	49	11	20	41	12
11	20	33	12	20	35	11	20	38	11	20	29	12
12	20	21	12	20	24	12	20	27	12	20	17	12
13	20	9	13	20	12	13	20	15	13	20	5	12
14	19	56	13	19	59	13	20	2	12	19	53	13
15	19	43	13	19	46	13	19	50	13	19	40	13
16	19	30	13	19	33	13	19	37	14	19	27	14
17	19	17	14	19	20	14	19	23	13	19	13	14
18	19	3	14	19	6	14	19	10	14	18	59	14
19	18	49	15	18	52	14	18	56	15	18	45	15
20	18	34	14	18	38	15	18	41	14	18	30	14
21	18	20	15	18	23	15	18	27	15	18	16	15
22	18	5	16	18	8	15	18	12	15	18	1	16
23	17	49	15	17	53	15	17	57	16	17	45	15
24	17	34	16	17	38	16	17	41	15	17	30	16
25	17	18	16	17	22	16	17	26	16	17	14	17
26	17	2	17	17	6	17	17	10	17	16	57	16
27	16	45	16	16	49	16	16	53	16	16	41	17
28	16	29	17	16	33	17	16	37	17	16	24	17
29	16	12	18	16	16	17	16	20	17	16	7	17
30	15	54	17	15	59	18	16	3	18	15	50	18
31	15	37		15	41		15	45		15	32	

North declination.

August.

Day.	1			2			3			4		
	1609 1613 1617			1610 1614 1618			1611 1615 1619			1612 1616 1620		
	De.	Mi.	dif.	De.	Mi.	dif.	De.	Mi.	dif.	De.	Mi.	dif.
1	15	19	18	15	24	18	15	28	18	15	14	18
2	15	1	18	15	6	19	15	10	18	14	56	18
3	14	43	19	14	47	18	14	52	19	14	38	19
4	14	24	18	14	29	19	14	33	18	14	19	18
5	14	6	19	14	10	19	14	15	19	14	1	19
6	13	47	19	13	51	19	13	56	19	13	42	20
7	13	28	20	13	32	19	13	37	19	13	22	19
8	13	8	19	13	13	19	13	18	20	13	3	20
9	12	49	20	12	54	20	12	58	21	12	43	19
10	12	29	20	12	34	20	12	39	20	12	24	20
11	12	9	21	12	14	20	12	19	20	12	4	21
12	11	48	20	11	54	21	11	59	21	11	43	20
13	11	28	20	11	33	20	11	38	20	11	23	21
14	11	8	21	11	13	21	11	18	21	11	2	21
15	10	47	21	10	52	21	10	57	21	10	41	21
16	10	26	21	10	31	21	10	36	21	10	20	21
17	10	5	21	10	10	21	10	15	21	9	59	21
18	9	44	21	9	49	21	9	54	21	9	38	21
19	9	23	22	9	28	22	9	33	21	9	17	22
20	9	1	22	9	6	21	9	12	22	8	55	22
21	8	39	21	8	45	22	8	50	22	8	33	22
22	8	18	22	8	23	22	8	28	22	8	11	22
23	7	56	22	8	1	22	8	6	22	7	49	22
24	7	34	23	7	39	22	7	44	22	7	27	22
25	7	11	22	7	17	23	7	22	22	7	5	22
26	6	49	23	6	54	22	7	0	22	6	43	22
27	6	26	22	6	32	23	6	37	23	6	20	23
28	6	4	23	6	9	22	6	15	22	5	58	22
29	5	41	22	5	47	23	5	52	23	5	35	23
30	5	19	23	5	24	23	5	30	22	5	12	23
31	4	56		5	1		5	7	23	4	49	23

North declination.

North declination.

September.

	1			2			3			4		
	1609 1613 1617			1610 1614 1618			1611 1615 1619			1612 1616 1620		
Day.	*De.*	*Mi.*	*dif.*	*De.*	*Mi.*	*dif.*	*De.*	*Mi.*	*dif.*	*De.*	*Mi.*	*dif.*
1	4	33	23	4	38	23	4	44	23	4	26	23
2	4	10	23	4	15	23	4	21	23	4	3	23
3	3	47	23	3	52	23	3	58	23	3	40	23
4	3	24	24	3	29	23	3	35	23	3	17	23
5	3	0	23	3	6	23	3	12	24	2	54	23
6	2	37	23	2	43	24	2	48	23	2	31	24
7	2	14	24	2	19	23	2	25	23	2	7	23
8	1	50	23	1	56	23	2	2	24	1	44	24
9	1	27	24	1	33	24	1	38	23	1	20	23
10	1	3	23	1	9	23	1	15	24	0	57	23
11	0	40	24	0	46	24	0	51	23	0	34	24
12	0	16	23	0	22	23	0	28	24	0	10	24
13	0	7	24	0	1	24	0	4	23	0	14	23
14	0	31	23	0	25	23	0	19	24	0	37	24
15	0	54	24	0	48	24	0	43	23	1	1	23
16	1	18	23	1	12	24	1	6	24	1	24	24
17	1	41	24	1	36	23	1	30	23	1	48	23
18	2	5	23	1	59	24	1	53	24	2	11	24
19	2	28	24	2	23	23	2	17	23	2	35	23
20	2	52	23	2	46	24	2	40	24	2	58	24
21	3	15	24	3	10	23	3	4	23	3	22	23
22	3	39	23	3	33	23	3	27	24	3	45	23
23	4	2	23	3	56	24	3	51	23	4	8	24
24	4	25	24	4	20	23	4	14	23	4	32	23
25	4	49	23	4	43	23	4	37	24	4	55	23
26	5	12	23	5	6	24	5	1	23	5	18	23
27	5	35	23	5	30	23	5	24	23	5	41	24
28	5	58	23	5	53	23	5	47	23	6	5	23
29	6	21	23	6	16	23	6	10	23	6	28	23
30	6	44		6	39		6	33		6	51	

North declination. *South declination.* *North declination.* Æquinoctiall. *South declination.*

October.

Day.	1			2			3			4		
	1609 1613 1617			1610 1614 1618			1611 1615 1619			1612 1616 1620		
	De.	Mi.	dif.	De.	Mi.	dif.	De.	Mi.	dif.	De.	Mi.	dif.
1	7	7	23	7	1	23	6	56	23	7	13	23
2	7	30	22	7	24	23	7	19	22	7	36	23
3	7	52	23	7	47	22	7	41	23	7	59	22
4	8	15	22	8	9	23	8	4	23	8	21	22
5	8	37	23	8	32	22	8	27	22	8	43	23
6	9	0	22	8	54	22	8	49	22	9	6	22
7	9	22	22	9	16	22	9	11	22	9	28	22
8	9	44	22	9	38	22	9	33	22	9	50	22
9	10	6	21	10	0	22	9	55	22	10	12	21
10	10	27	22	10	22	22	10	17	22	10	33	22
11	10	49	22	10	44	21	10	39	21	10	55	21
12	11	11	21	11	5	22	11	0	21	11	16	22
13	11	32	21	11	27	21	11	21	22	11	38	21
14	11	53	21	11	48	21	11	43	21	11	59	20
15	12	14	20	12	9	20	12	4	20	12	19	21
16	12	34	21	12	29	21	12	24	21	12	40	21
17	12	55	20	12	50	20	12	45	20	13	1	20
18	13	15	20	13	10	20	13	5	21	13	21	20
19	13	35	20	13	30	20	13	26	20	13	41	20
20	13	55	20	13	50	20	13	46	19	14	1	19
21	14	15	19	14	10	20	14	5	20	14	20	20
22	14	34	20	14	30	19	14	25	19	14	40	19
23	14	54	19	14	49	19	14	44	19	14	59	19
24	15	13	18	15	8	19	15	3	19	15	18	18
25	15	31	19	15	27	18	15	22	19	15	36	19
26	15	50	18	15	45	18	15	41	18	15	55	18
27	16	8	18	16	3	18	15	59	18	16	13	18
28	16	26	17	16	21	18	16	17	18	16	31	17
29	16	43	18	16	39	18	16	35	17	16	48	17
30	17	1	17	16	57	17	16	52	18	17	5	17
31	17	18		17	14		17	10		17	22	

South declination.

South declination.

Nouember.

South declination.

Day.	1			2			3			4		
	1609 1613 1617			1610 1614 1618			1611 1615 1619			1612 1616 1620		
	De.	Mi.	dif.	De.	Mi.	dif.	De.	Mi.	dif.	De.	Mi.	dif.
1	17	35	16	17	31	16	17	26	17	17	39	16
2	17	51	16	17	47	16	17	43	16	17	55	16
3	18	7	16	18	3	16	17	59	16	18	11	16
4	18	23	16	18	19	16	18	15	16	18	27	16
5	18	39	15	18	35	15	18	31	15	18	43	15
6	18	54	15	18	50	15	18	46	15	18	58	15
7	19	9	14	19	5	14	19	1	15	19	13	14
8	19	23	14	19	19	15	19	16	14	19	27	14
9	19	37	14	19	34	13	19	30	14	19	41	14
10	19	51	13	19	47	14	19	44	14	19	55	13
11	20	4	13	20	1	13	19	58	13	20	8	13
12	20	17	13	20	14	13	20	11	13	20	21	13
13	20	30	12	20	27	12	20	24	12	20	34	12
14	20	42	12	20	39	12	20	36	12	20	45	12
15	20	54	12	20	51	12	20	48	12	20	57	11
16	21	6	11	21	3	11	21	0	11	21	8	11
17	21	17	10	21	14	11	21	11	11	21	19	11
18	21	27	11	21	25	10	21	22	11	21	30	10
19	21	38	9	21	35	10	21	33	10	21	40	10
20	21	47	10	21	45	10	21	43	10	21	50	9
21	21	57	9	21	55	9	21	53	9	21	59	9
22	22	6	8	22	4	8	22	2	9	22	8	9
23	22	14	9	22	12	9	22	11	8	22	17	8
24	22	23	7	22	21	8	22	19	8	22	25	8
25	22	30	8	22	29	7	22	27	7	22	33	7
26	22	38	6	22	36	7	22	34	7	22	40	7
27	22	44	7	22	43	6	22	41	7	22	47	6
28	22	51	5	22	49	6	22	48	6	22	53	6
29	22	56	6	22	55	6	22	54	6	22	59	5
30	23	2		23	1		23	0		23	4	

South declination.

December.

Day.	1			2			3			4		
	1609 1613 1617			1610 1614 1618			1611 1615 1619			1612 1616 1620		
	De.	Mi.	dif.	De.	Mi.	dif.	De.	Mi.	dif.	De.	Mi.	dif.
1	23	7	5	23	6	5	23	5	5	23	8	5
2	23	12	4	23	11	4	23	10	4	23	13	4
3	23	16	4	23	15	4	23	14	4	23	17	3
4	23	20	3	23	19	3	23	18	3	23	20	3
5	23	23	2	23	22	3	23	21	3	23	23	3
6	23	25	2	23	25	2	23	24	3	23	26	2
7	23	27	2	23	27	2	23	26	2	23	28	2
8	23	29	1	23	29	1	23	28	2	23	30	1
9	23	30	1	23	30	1	23	30	2	23	31	1
10	23	31	0	23	31	0	23	31	1	23	31	0
11	23	31	0	23	31	0	23	31	0	23	31	0
12	23	31	0	23	31	0	23	31	0	23	31	1
13	23	31	1	23	31	1	23	31	1	23	30	1
14	23	30	2	23	30	2	23	30	1	23	29	2
15	23	28	2	23	28	2	23	29	2	23	27	2
16	23	26	3	23	26	2	23	27	2	23	25	3
17	23	23	3	23	24	3	23	25	3	23	22	3
18	23	20	3	23	21	3	23	22	3	23	19	3
19	23	17	4	23	18	3	23	19	3	23	16	4
20	23	13	5	23	14	4	23	15	4	23	12	5
21	23	8	5	23	10	4	23	11	4	23	7	5
22	23	3	5	23	5	5	23	6	5	23	2	5
23	22	58	6	23	0	5	23	1	5	22	57	6
24	22	52	6	22	54	6	22	55	6	22	51	7
25	22	46	7	22	48	7	22	49	6	22	44	7
26	22	39	7	22	41	7	22	43	7	22	37	7
27	22	32	7	22	34	8	22	36	7	22	30	8
28	22	25	8	22	26	8	22	29	8	22	22	8
29	22	17	9	22	18	8	22	21	8	22	14	8
30	22	8	9	22	10	9	22	13	9	22	6	9
31	21	59		22	1		22	4		21	57	

South declination.

South declination.

By the height of the Pole ſtarre to know the height of the Pole.

THe tables following are calculated for the end of the yeere 1610, ſeruing without ſenſible error for many yeeres to come; they ſhew the height of the Pole for conuenient latitudes, by the height of the Pole ſtarre, and the helpe of the guards, in eight ſeuerall poſitions: ſo that you may by helpe of them, in any place on the North ſide of the æquator, to the latitude of 74 degrees, or further, once in three houres euery cleere night, make a good obſeruation of the latitude. In the three laſt poſitions, if the height of the Pole be but little, the guards will be hid vnder the Horizon: notwithſtanding if by the houre of the night, or the height of any knowne ſtarre, by the helpe of a Globe, or Aſtrolabe, wee know when the ſtaires doe come to their due poſition, we may obſerue the Pole ſtarre, and finde the height of the Pole nere as well, as if they were aboue the Horizon. The poſitions are carefully to be obſerued, that the two ſtarres mentioned in the head of the table be either in the ſame Azimuth one directly ouer another (which is knowne, if looking with the one eye onely, a perpendicular corde will hide or couer them both) or elſe of the ſame altitude aboue the Horizon, which is diſcerned by the Croſſe-ſtaffe. At that inſtant that any ſuch poſition ſhall happen, take the height of the Pole ſtarre and the table anſwering to that poſition, ſhall giue you the height of the Pole.

For example; when the greater guard is directly vnder the Pole ſtarre, I finde the height of the Pole ſtarre to be 47 degrees and twentie minutes: I looke in the ſeuenth table, and find the height of the Pole for 47, to be 44 degrees, 36 minutes: to this I adde 20 minutes, becauſe the height of the ſtarre is 20 minutes aboue 47, then is the height of the Pole 44 degrees, 56 min. The ſeconds may ſafely be neglected, though they be inſerted in the table rather for ſatisfaction of the reader, in the certaintie of the calculation, then for any neceſſarie vſe.

If when the greater guard is in the Eaſt, of equall height with the Pole ſtarre, I finde the height of that ſtarre to be 75 degrees, 40 minutes. In the firſt table I finde the height of the Pole anſwering to 75 deg. to be 77 deg. 26 min. and the difference one degree, three minutes: the part proportionall whereof for 40 minutes, is 42 min. which added to 77 degrees, 26 min. maketh the true eleuation of the Pole 78 degrees, 8 minutes.

Where the height of the Pole ſtarre is but little, there wee muſt ſubduct the refraction from the height obſerued: otherwiſe we ſhall alwaies finde the height more then in truth it is. This refraction cauſeth the obſeruations of the Sunne at the South, and at the North, (when the Sunne neuer ſetteth in Northren climates) to giue ſeuerall latitudes in the ſame place, the obſeruation at the North alwaies making the latitude too great. Concerning this refraction, ſee page 232.

When

When the greater guard is in the Eaſt of the ſame height with the Pole ſtarre.

Height of the Pole ſtarre.	Height of the Pole.			Height of the Pole ſtarre.	Height of the Pole.			Height of the Pole ſtarre.	Height of the Pole.		
Deg.	De	mi.	Se.	Deg.	De	mi.	Se.	Deg.	De	mi.	Se.
1	2	26	49	28	29	35	46	55	56	50	52
2	3	27	8	29	30	36	9	56	57	51	46
3	4	27	26	30	31	36	33	57	58	52	42
4	5	27	44	31	32	36	57	58	59	53	41
5	6	28	2	32	33	37	22	59	[illegible]	54	44
6	7	28	21	33	34	37	47	60	61	55	50
7	8	28	40	34	35	38	13	61	62	57	0
8	9	28	58	35	36	38	39	62	63	58	14
9	10	29	17	36	37	39	6	63	64	59	33
10	11	29	36	37	38	39	34	64	66	0	58
11	12	29	55	38	39	40	3	65	67	2	28
12	13	30	14	39	40	40	31	66	68	4	3
13	14	30	33	40	41	41	1	67	69	5	46
14	15	30	53	41	42	41	32	68	70	7	38
15	16	31	12	42	43	42	3	69	71	9	40
16	17	31	32	43	44	42	36	70	72	11	13
17	18	31	52	44	45	43	9	71	73	14	20
18	19	32	11	45	46	43	44	72	74	17	0
19	20	32	32	46	47	44	20	73	75	19	54
20	21	32	52	47	48	44	57	74	76	23	0
21	22	33	13	48	49	45	36	75	77	26	19
22	23	33	34	49	50	46	15	76	78	29	51
23	24	33	55	50	51	46	57	77	79	33	36
24	25	34	17	51	52	47	40	78	80	37	36
25	26	34	38	52	53	48	25	79	81	41	49
26	27	35	1	53	54	49	12	80	82	46	17
27	28	35	23	54	55	50	1				

When the two guards are of equall height betwixt the East and the highest.

Height of the Pole starre.	Height of the Pole.			Height of the Pole starre.	Height of the Pole.			Height of the Pole starre.	Height of the Pole.		
Deg.	De	mi.	Se.	Deg.	De	mi.	Se.	Deg.	De	mi.	Se.
1	3	46	20	28	30	46	37	55	57	42	26
2	4	46	23	29	31	46	36	56	58	41	57
3	5	46	25	30	32	46	33	57	59	41	26
4	6	46	27	31	33	46	31	58	60	40	51
5	7	46	29	32	34	46	29	59	61	40	11
6	8	46	31	33	35	46	26	60	62	39	26
7	9	46	32	34	36	46	22	61	63	38	36
8	10	46	34	35	37	46	19	62	64	37	39
9	11	46	36	36	38	46	15	63	65	36	34
10	12	46	37	37	39	46	10	64	66	35	19
11	13	46	38	38	40	46	5	65	67	33	53
12	14	46	39	39	41	46	0	66	68	32	14
13	15	46	40	40	42	45	54	67	69	30	19
14	16	46	41	41	43	45	47	68	70	28	3
15	17	46	42	42	44	45	40	69	71	25	21
16	18	46	43	43	45	45	32	70	72	22	7
17	19	46	43	44	46	45	23	71	73	18	13
18	20	46	43	45	47	45	14	72	74	13	30
19	21	46	43	46	48	45	3	73	75	7	36
20	22	46	43	47	49	44	52	74	76	0	4
21	23	46	44	48	50	44	39	75	76	50	17
22	24	46	43	49	51	44	25	76	77	36	46
23	25	46	43	50	52	44	10	77	78	17	2
24	26	46	42	51	53	43	53	78	78	47	20
25	27	46	41	52	54	43	35				
26	28	46	40	53	55	43	14				
27	29	46	39	54	56	42	51				

When the greateſt guard is directly aboue the Pole ſtarre.

Height of the Pole ſtarre.	Height of the Pole.			Height of the Pole ſtarre.	Height of the Pole.			Height of the Pole ſtarre.	Height of the Pole.		
Deg.	De	mi.	Se.	Deg.	De	mi.	Se.	Deg.	De	mi.	Se.
1	3	22	29	28	30	21	55	55	57	20	51
2	4	22	28	29	31	21	53	56	58	20	47
3	5	22	27	30	32	21	52	57	59	20	43
4	6	22	26	31	33	21	50	58	60	20	38
5	7	22	25	32	34	21	48	59	61	20	34
6	8	22	23	33	35	21	47	60	62	20	28
7	9	22	22	34	36	21	45	61	63	20	23
8	10	22	21	35	37	21	43	62	64	20	17
9	11	22	20	36	38	21	41	63	65	20	11
10	12	22	19	37	39	21	39	64	66	20	4
11	13	22	17	38	40	21	38	65	67	19	57
12	14	22	16	39	41	21	36	66	68	19	48
13	15	22	15	40	42	22	33	67	69	19	40
14	16	22	14	41	43	21	31	68	70	19	30
15	17	22	13	42	44	21	29	69	71	19	20
16	18	22	11	43	45	21	27	70	72	19	8
17	19	22	10	44	46	21	25	71	73	18	55
18	20	22	9	45	47	21	22	72	74	18	40
19	21	22	7	46	48	21	20	73	75	18	23
20	22	22	6	47	49	21	17	74	76	18	4
21	23	22	5	48	50	21	14	75	77	17	42
22	24	22	3	49	51	21	11				
23	25	22	2	50	52	21	8				
24	26	22	1	51	53	21	5				
25	27	21	59	52	54	21	2				
26	28	21	58	53	55	20	59				
27	29	21	56	54	56	20	55				

When the two guards are directly one ouer another betwixt the highest and the west.

Height of the Pole starre.	Height of the Pole.			Height of the Pole starre.	Height of the Pole.			Height of the Pole starre.	Height of the Pole.		
Deg.	De	mi.	Se.	Deg.	De	mi.	Se.	Deg.	De	mi.	Se.
1	1	20	22	28	28	38	3	55	56	8	51
2	2	20	58	29	29	38	50	56	57	10	44
3	3	21	34	30	30	39	37	57	58	12	43
4	4	22	11	31	31	40	25	58	59	14	49
5	5	22	47	32	32	41	15	59	60	17	2
6	6	23	23	33	33	42	5	60	61	19	23
7	7	24	0	34	34	42	57	61	62	21	53
8	8	24	37	35	35	43	50	62	63	24	34
9	9	25	13	36	36	44	44	63	64	27	25
10	10	25	50	37	37	45	40	64	65	30	30
11	11	26	28	38	38	46	37	65	66	33	48
12	12	27	5	39	39	47	35	66	67	37	23
13	13	27	43	40	40	48	36	67	68	41	16
14	14	28	21	41	41	49	38	68	69	45	30
15	15	29	0	42	42	50	42	69	70	50	7
16	16	29	38	43	43	51	48	70	71	55	13
17	17	30	18	44	44	52	56	71	73	0	52
18	18	30	57	45	45	54	7	72	74	7	9
19	19	31	37	46	46	55	20	73	75	14	8
20	20	32	18	47	47	56	36	74	76	21	52
21	21	32	59	48	48	57	55				
22	22	33	40	49	49	59	17				
23	23	34	22	50	51	0	43				
24	24	35	5	51	52	2	12				
25	25	35	48	52	53	3	45				
26	26	36	33	53	54	5	22				
27	27	37	17	54	55	7	4				

When the greater guard is in the weſt, of the ſame height with the Pole ſtarre.

Height of the Pole ſtarre.	Height of the Pole.			Height of the Pole ſtarre.	Height of the Pole.			Height of the Pole ſtarre.	Height of the Pole.		
Deg.	De	mi.	Se.	Deg.	De	mi.	Se.	Deg.	De	mi.	Se.
2	0	34	7	29	27	43	27	56	55	0	53
3	1	34	26	30	28	43	52	57	56	2	1
4	2	34	44	31	29	44	18	58	57	3	12
5	3	35	3	32	30	44	44	59	58	4	26
6	4	35	22	33	31	45	11	60	59	5	43
7	5	35	41	34	32	45	39	61	60	7	8
8	6	36	0	35	33	46	7	62	61	8	39
9	7	36	19	36	34	46	36	63	62	10	18
10	8	36	38	37	35	47	6	64	63	12	5
11	9	36	57	38	36	47	37	65	64	13	59
12	10	37	17	39	37	48	8	66	65	16	4
13	11	37	36	40	38	48	40	67	66	18	21
14	12	37	56	41	39	49	15	68	67	20	53
15	13	38	16	42	40	49	49	69	68	23	37
16	14	38	37	43	41	50	25	70	69	26	38
17	15	38	57	44	42	51	2	71	70	29	40
18	16	39	18	45	43	51	40	72	71	33	13
19	17	39	39	46	44	52	21	73	72	37	28
20	18	40	0	47	45	53	3	74	73	42	42
21	19	40	21	48	46	53	46	75	74	49	8
22	20	40	43	49	47	54	31	76	75	56	59
23	21	41	5	50	48	55	17	77	77	6	26
24	22	41	28	51	49	56	7	78	78	17	40
25	23	41	51	52	50	56	59	79	79	30	54
26	24	42	14	53	51	57	53	80	80	46	22
27	25	42	38	54	52	58	49				
28	26	43	2	55	53	59	48				

When the two guards are of equall height betwixt the West and the lowest.

Height of the Pole starre.	Height of the Pole.			Height of the Pole starre.	Height of the Pole.			Height of the Pole starre.	Height of the Pole.		
Deg.	De	mi.	Se.	Deg.	De	mi.	Se.	Deg.	De	mi.	Se.
3	0	13	50	30	27	16	9	57	54	24	47
4	1	13	53	31	28	16	17	58	55	25	31
5	2	13	56	32	29	16	26	59	56	26	19
6	3	14	0	33	30	16	36	60	57	27	12
7	4	14	3	34	31	16	46	61	58	28	10
8	5	14	6	35	32	16	56	62	59	29	14
9	6	14	10	36	33	17	7	63	60	30	26
10	7	14	14	37	34	17	18	64	61	31	45
11	8	14	18	38	35	17	30	65	62	33	14
12	9	14	22	39	36	17	43	66	63	34	54
13	10	14	26	40	37	17	56	67	64	36	47
14	11	14	30	41	38	18	10	68	65	38	57
15	12	14	35	42	39	18	25	69	66	41	26
16	13	14	39	43	40	18	40	70	67	44	22
17	14	14	44	44	41	18	57	71	68	47	48
18	15	14	49	45	42	19	14	72	69	51	48
19	16	14	55	46	43	19	33	73	70	56	40
20	17	15	0	47	44	19	53	74	72	2	46
21	18	15	6	48	45	20	14	75	73	10	39
22	19	15	12	49	46	20	36	76	74	21	29
23	20	15	18	50	47	21	0	77	75	37	16
24	21	15	24	51	48	21	26	78	77	1	13
25	22	15	31	52	49	21	53				
26	23	15	38	53	50	22	23				
27	24	15	45	54	51	22	55				
28	25	15	53	55	52	23	29				
29	26	16	1	56	53	24	7				

When the greater guard is directly vnder the Pole ſtarre.

Height of the Pole ſtarre.	*Height of the Pole.*		
Deg.	*De*	*mi.*	*Se.*
3	0	37	26
4	1	37	25
5	2	37	24
6	3	37	23
7	4	37	22
8	5	37	21
9	6	37	19
10	7	37	18
11	8	37	17
12	9	37	16
13	10	37	15
14	11	37	14
15	12	37	12
16	13	37	11
17	14	27	10
18	15	37	9
19	16	37	7
20	17	37	6
21	18	37	5
22	19	37	4
23	20	37	2
24	21	37	1
25	22	37	0
26	23	36	58
27	24	36	57
28	25	36	56
29	26	36	54
30	27	36	53
31	28	36	51
32	29	36	50
33	30	36	48
34	31	36	47
35	32	36	45
36	33	36	44
37	34	36	42
38	35	36	40
39	36	36	38
40	37	36	37
41	38	36	35
42	39	36	33
43	40	36	31
44	41	36	29
45	42	36	27
46	43	36	25
47	44	36	23
48	45	36	20
49	46	36	18
50	47	36	15
51	48	36	13
52	49	36	10
53	50	36	7
54	51	36	5
55	52	36	2
56	53	35	58
57	54	35	55
58	55	35	52
59	56	35	48
60	57	35	44
61	58	35	40
62	59	35	36
63	60	35	31
64	61	35	26
65	62	35	21
66	63	35	15
67	64	35	10
68	65	35	3
69	66	34	56
70	67	34	49
71	68	34	40
72	69	34	31
73	70	34	22
74	71	34	11
75	72	33	59
76	73	33	45
77	74	33	30
78	75	33	13
79	76	32	54
80	77	32	30
81	78	32	4
82	79	31	34
83	80	30	54
84	81	30	7
85	82	29	7
86	83	27	50

When the two guards are in the ſame Azimuth, or the one directly ouer the other betwixt the loweſt and the Eaſt.

Height of the Pole ſtarre.	Height of the Pole.			Height of the Pole ſtarre.	Height of the Pole.			Height of the Pole ſtarre.	Height of the Pole.		
Deg.	De	mi.	Se.	Deg.	De	mi.	Se.	Deg.	De	mi.	Se.
1	0	40	50	28	27	58	43	55	55	30	47
2	1	41	27	29	28	59	31	56	56	32	47
3	2	42	3	30	30	0	19	57	57	34	54
4	3	42	39	31	31	1	9	58	58	37	9
5	4	43	16	32	32	1	59	59	59	39	32
6	5	43	52	33	33	2	51	60	60	42	4
7	6	44	29	34	34	3	44	61	61	44	46
8	7	45	6	35	35	4	39	62	62	47	41
9	8	45	43	36	36	5	34	63	63	50	48
10	9	46	20	37	37	6	32	64	64	54	11
11	10	46	58	38	38	7	30	65	65	57	51
12	11	47	36	39	39	8	31	66	67	1	49
13	12	48	14	40	40	9	33	67	68	6	11
14	13	48	52	41	41	10	38	68	69	10	59
15	14	49	31	42	42	11	44	69	70	16	16
16	15	50	10	43	43	12	53	70	71	22	11
17	16	50	50	44	44	14	4	71	72	28	54
18	17	51	30	45	45	15	17	72	73	36	34
19	18	52	10	46	46	16	33	73	74	45	18
20	19	52	52	47	47	17	53	74	75	55	14
21	20	53	33	48	48	19	15				
22	21	54	15	49	49	20	41				
23	22	54	58	50	50	22	11				
24	23	55	42	51	51	23	45				
25	24	56	26	52	52	25	23				
26	25	57	11	53	53	27	5				
27	26	57	57	54	54	28	54				

THE CONTENTS OF THIS TREATISE OF THE ART of Nauigation.

The diuiſion of the whole art of Nauigation. pag. 1

Chap. 1. *The definition of the Sphære.* 2

2. *That the whole world is a Sphære.* 2

3. *Of the diuiſion of the Sphære.* 2

4. *Of the motion of the heauens.* 4

5. *Of the figure of the heauens.* 5

6. *That the earth and water make one perfect globe.* 6

7. *That the earth is in the center of the world.* 6

8. *The whole quantitie of the earth.* 7

9. *Of the Æquinoctiall circle.* 7

10. *Of the Poles of the world.* 8

11. *Of the ecliptick line.* 9

12. *Of the declination of the Sunne.* 10

13. *Of the colures.* 10

14. *Of the Meridian circle.* 12

15. *Of the Horizon.* 13

16. *Of the 32 windes.* 14

17. *Of the two Tropicks.* 17

18. *Of the Parallels.* 18

19. *Of the degrees.* 19

20. *What is meant by longitude and latitude.* 20

THE SECOND PART OF THE ART OF Nauigation: wherein is handled the Practick part, ſhewing the making and vſe of the principal Inſtruments belonging to this Art.

Chap. 1. *The making of the Aſtrolabe.* pag. 21

2. *Of the height of the Sunne.* 24

Of

The Contents of this Treatiſe.

Chap. 3. *Of the Shadowes.* pag. 25
4. *Of the Regiment and rules of the Sunne.* 26
5. *Of the declination of the Sunne, and of the tables thereof.* 29
How the declination of the Sun may be found out. 30
6. *The æquation of the Sunnes declination.* 31
7. *Foure examples for the plainer declaration of that which is ſaid before.* 32
8. *Another manner of accounting by the Sunne, as they vſe in Portugall.* 35
9. *How the height of the Sunne may be knowne in any place whatſoeuer without an Aſtrolabe; firſt knowing your diſtance from the æquinoctial.* 36
10. *The rule or Regiment of the North ſtarre for the knowledge of the height of the Pole.* 38
11. *The making of the Croſſe-ſtaffe.* 39
12. *Of the poſition of the North ſtarre, and the guards.* 41
13. *Of the height of the ſtarre taken with the Croſſe-ſtaffe.* 43
14. *The regiment or rules of the North ſtarre.* 43
15. *Other things to be noted in obſeruing the height of the pole.* 46
16. *Of the Croſiers.* 48
17. *Of the Sea-compaſſe.* 49
18. *How the variatiõ of the Compaſſe may be found.* 53
The finding of the Meridian line. 53
19. *Of the Sea-chart.* 55
20. *Of the point of imagination.* 59
21. *Of the trauerſe or geometricall point.* 61
22. *Of the amending of the point of imagination.* 62
The amending of the point of imagination by the trauerſe point. 63
The amendment of the point of imagination by North, South, Eaſt, Weſt. 63
23. *The point by imagination and the height.* 64
24. *What it is to increaſe or diminiſh in height.* 66

How

The Contents of this Treatise.

Chap. 25. *How you may cast a traverse point without compasses.* pag. 67

26. *Of another kinde of casting a point by traverse.* 68

27. *Of the leagues which in Navigation answere to each degree of latitude in every Rumbe.* 69

28. *How you may come to know the longitude, or the course from East to West.* 70

29. *How you may set downe in your Chart a new land never before discovered.* 73

30. *Seeing two knowne points or capes of land as you saile along, how you may know the distance of the shippe from them.* 74

31. *Of the account of the Moone.* 75

The first rule of the golden number. 77

The second rule of the concurrent. 78

The third rule of the coniunction. 78

The fourth rule, of the full, and quarters of the Moone. 79

The fift rule of the spring-tides, and neap-tides. 79

An example whereby the foresaid rules are made more plaine. 79

32. *Of the daily tides.* 81

The first rule. 82

The second rule. 82

The third rule. 83

The fourth rule. 83

The fifth rule. 83

An example of the said rules. 84

33. *Of a certaine Instrument, whereby you may in generall iudge of the tides.* 85

The vse of this Instrument. 87

34. *Of the making of an vniuersall Diall, which may serue generally all the world ouer.* 88

35. *Of the parts of this Instrument.* 92

36. *How you may know what a clock it is by this Instrument.* 93

37. *Of the variation of the Compasse by this Instrument.*

ment. 94
Chap.38. At what houre the Sunne riſeth and ſetteth euery day, in all parts of the world. 95
Chap.39. Of the length of the day and of the night. 96
Chap.40. Of a night Diall by the North ſtarres. 96
The vſe of the table of the Sunnes declination. 100
A table of the Sunnes declination. 101
By the height of the Pole ſtarre to know the height of the Pole: 113
1 When the greater or former guard is in the Eaſt of the ſame height with the Pole ſtarre. 115
2 When the two guards are of equall heigth betwixt the Eaſt and the higheſt. 116
3 When the greateſt or formoſt guard is right aboue the Pole-ſtarre. 117
4 When the two guards are directly one ouer another betwixt the higheſt and the weſt. 118
5 When the greater or formoſt guard is in the weſt of the ſame height with the Pole-ſtarre. 119
6 When the two guards are of equall height betwixt the weſt and the loweſt. 120
7 When the greater or former guard is directly vnder the Pole-ſtarre. 121
8 When the two guards are directly the one ouer the other, betwixt the loweſt and the Eaſt. 122

FINIS.

An Addition touching the variation of the *Compaſſe*.

WHereas there haue been ſome of opinion that there be two Magneticall poles, by knowledge whereof, and of the magneticall variation obſerued in any place, they haue imagined they could finde the longitude thereof: to ſhew the great error and vncertaintie of this their opinion, I haue here ſet downe this Table of obſeruations of the variation of the Magneticall Needle, which partly by my ſelfe, but for the moſt part by others, both Engliſh and ſtrangers haue bin taken in all parts of the world almoſt, whither any Nauigation hath bin made, for theſe many yeeres. Which obſeruations I wiſh the iudicious reader to compare together with ſo good aduice and iudgement as he can: whereby I aſſure my ſelfe he will bee enforced to acknowledge with me, that there can bee no ſuch magneticall poles found, as they imagine. To proue this, a few inſtances may be ſufficient amongſt many that may be gathered out of theſe obſeruations. For if there bee two ſuch Magneticall poles, there can be but one common magneticall meridian paſſing by them and the poles of the world: but by theſe obſeruations it is manifeſt that there be many magneticall meridians paſſing by the poles of the world: as namely, the magne-

ticall meridian about *Trinidado* and *Barbudas*: alſo the meridian about the weſtermoſt of the *Azores*: alſo about *P.das Agulhas*: laſtly, amongſt the Eaſt Indian Ilands ſomewhat beyond *Iaua Maior*, the magneticall and true meridian muſt needes agree in one. Now ſeeing that all theſe magneticall meridians paſſe by the poles of the world, there can be no reaſon giuen why the magneticall poles ſhould be ſaid to be in one of them more then in another: and if in any, then in all: whereof it muſt needs follow, that as many magneticall meridians as you haue that paſſe by the poles of the world, ſo many paire of magneticall poles muſt you haue, which is abſurd; and therefore no ſuch magneticall poles.

Now if any ſhall thinke that the great difference that is found betwixt diuers of theſe obſeruations, taken at the ſame place by diuers obſeruers, doth make any thing againſt the intention of this argument, he is much deceiued. For although there be three or foure degrees difference betwixt ſome obſeruations taken at the ſame place; as namely at S.*Helena*, ſome make the variation to be almoſt three degrees, ſome almoſt foure: others will haue it to be about fiue degrees and an halfe, and ſome others ſeuen and an halfe. And although there bee ſome foure or fiue ſcore leagues difference in determining the place where the true and magneticall meridian ſhould concurre, or where there ſhould be no variation about *Flores* & *Coruo*, and about *P.das Agulhas*, ſome making it to bee about ſeuentie or eightie leagues Weſtward from *Flores*; and ſome about thirtie leagues Eaſtward from thence; where

ſome

ſome others will haue it hard by *Flores*, or ſomwhat to the Eaſtwards thereof: And at *P. das Agulhas* ſome ſay there is no variation at all, but according to others wee muſt goe 80 leagues further to the Eaſtward before wee come to no variation. All theſe differences notwithſtanding how great ſoeuer they be, can be of no validitie to infringe the force of the foreſaid argument; for ſtill theſe obſeruations will neceſſarily proue, that either at *Flores* and at *P. das Agulhas*, or at the moſt within three or foure ſcore leagues of thoſe places, there is a magneticall meridian paſſing by both the poles of the world; which two meridians differing ſo much in longitude each from other, and hauing in all latitudes great variations betwixt them, it cannot be with any reaſon imagined how they may bee reduced into one, ſo to make two magneticall poles only. But of all theſe ſo great differences either of the ſame or of diuers mens obſeruations, we may iuſtly take occaſion to admoniſh all ſea-men, eſpecially ſuch as are to take charge, that they be very carefull both in prouiding themſelues of the moſt conuenient inſtruments that can be gotten for this purpoſe, and alſo in the circumſpect and artificial handling of them whenſoeuer they goe about to make vſe of them in obſeruing to finde the variation, conſidering how great and excellent vſe there may bee made hereof, for finding out the place whereabouts you are betwixt Eaſt and Weſt vpon the huge and vaſt Ocean, though you haue ſeene no land for a long time.

	Variat. Weſt. De. Mi.	*Latit. North.* De. Mi.
In the Ice hauen at Noua zembla	22 30	76 0
On the Weſt ſide of Noua zembla	26 0	76 0
From Noua zembla Weſtward 20 leagues	31 0	73 0
At Croſſe Iland neere Noua zembla	17 0	
At the Hollanders Newland	16 0	81 0
In the Iland of Vaygats	7 0	71 0
Amongſt the Iles of Vaygats	8 0	70 25
At S. Iames Ile	7 30	70 40
On land neere the barre of Pechora	3 30	69 10
At the North Cape	1 0	71 30
From Fowlay Iland halfe way almoſt to Friſland	11 15	
From Friſeland halfe way to Labrador, now called Newfoundland	28 0	62 0
	Eaſt.	
Neere England ſayling from Yarmouth Northwards	12 40	55 14
In the way from London to Ruſſia	13 0	55 20
	Weſt.	
	3 30	69 0
	7 0	70 40
	8 0	70 30
	Eaſt.	
	4 0	65 40
	5 10	64 30
	3 0	66 30

	Variat. East.		*Latit. North.*	
	De.	*Mi*	*De.*	*Mi.*
At Antwerpe in Brabant	9	0		
Neere London at Limehouse	11	0	51	32
	11	15		
About Portland	10	0		
In S. Iues Churchyard in Cornwall	8	0	50	30
From Cape Lizard South by West 8. leag.	12	50	49	55
South easterlie from C. Cleare comming from our Channell	7	36		
At Youghall in Ireland	10	0		
At Syllie	10	0		
From Bell Ile eastward 350 leagues	1	0	52	10
From Syllie West Northwest 235 leagues	0	0	54	0
	West.			
From Syllie West Northwest fiue hundred and thirtie leagues	10	0	60	0
From that place Northwest by North	16	0	63	30
From thence North and by West	22	0	66	0
From this last place North by West	28	0	73	0
From thence due West 40 leagues	33	0	73	0
At the Earle of Cumberlands Iles	30	0	64	0
At Hope Sanderson	28	0	72	12
At Cape Rase in Newfoundland	16	0	47	0
Frō Cape Rase South by West Southerly	2	52	34	35
	5	37	35	30
From C. Rase South Southwest Southerly	6	30	39	40
	East.			
At Cape Finisterre	8	30		
From Cape Finister West by N. 38 leagues	7	55	43	20

	Variat. East. De. Mi.	Latit. North. De. Mi.
From the Rock { Westward about 50 leag.	6 15	39 10
From the Rock { West Northwest 7 leag.	7 0	
About Lisbone	6 30	
From Lisbone to C. Verde almost	8 30	
From C. Saker 3 or 4 leagues Eastward	5 38	
From S. Maries (one of the Azores) 9 leag. East by South	2 20	
At Fayal, and from thence to Tercæra	3 45	
From Tercæra to Lisbone {	7 30	
From Tercæra to Lisbone {	8 30	
From Flores Eastward scarce 40 leagues, and from C. Blanco 300 leagues	4 0	
From Flores Eastward 70 or 80 leagues	0 0	
Hard by Flores or betwixt it and Fayal	0 0	
From Flores Westward 30 leagues	0 0	
	West.	
Crossing the meridian of Flores & Coruo	1 0	
From Flores 100 or 120 leagues Westward {	2 0	
From Flores 100 or 120 leagues Westward {	1 0	
Within sight of Flores Southeast frō thence	5 37	
From Flores West 230 leagues	3 30	39 19
Falling with the Pike	1 30	
From the Canaries 300 leagues	1 0	19 0
	East.	
At the Canaries	5 37	
From the Grand Canarie Northward	4 37	32 0
Northeast from the Ile Saluages	5 37	31 0
On the Southwest side of ỹ Grand Canarie	5 20	28 0
From the Canaries 230 leagues	0 0	20 0

Sailing

	Variat. East. De. Mi.	Latit. North. De. Mi.
Sailing for the Canaries from the West Indies	0 0	33 0
	0 0	31 0
Sailing further in	5 37	27 20
From Palma sailing towards Cape Blanco	3 0	24 0
Neere to C.Blanco not two leag.frō shore	2 40	21 0
Riding at anchor neere C.Blanco	3 0	20 25
From C.Blanco West S.w. some 20 leag.	2 40	
From C.Blanco Westward 63 leagues	5 37	19 20
From C.Blanco Westward 90 leagues	5 0	18 35
From C.Blanco Westward 100 leagues	6 0	
From C.Blanco 436 leagues	7 30	17 42
From C.Blanco 470 leagues	7 30	11 57
From C.Blanco 476 leagues	7 36	16 35
From C.Blanco 535 leagues	7 30	10 59
From C.Blanco 595 leagues	5 0	10 15
From C. Blanco 640 leagues	4 36	10 0
From C.Blanco 700 leagues Westward	1 3	9 20
From C.Blanco going towards the West Indies in many distances	6 0	
	5 40	14 54
At Cape Verde	7 0	
About the Ilands of C.Verde	4 0	
From these Ilands 300 leagues Westward	5 38	
At S.Iago and S.Nicholas Iles of C.Verde	2 30	
From C.Verde 100 or 120 leagues	3 45	14 0
Frō ỳ Iles of Braua & Fogo W.N.w.12 leag.	4 30	
From Maio 46 leagues East by South	5 8	14 20
From Cape Verde in the way to the East Indies passing the æquinoctial	4 0	
	5 0	
	5 37	

	Variat. Eaſt. De.	Mi.	*Latit. North.* De.	Mi.
At the Iland of Trinidado	0	0	9	46
From Trinidado Iland eaſtw. 90 leag.	1	30		
	2	0		
	Weſt.			
At Margarita	0	0		
At S. Cruce neere S. Iohn de Porto Rico	0	0		
At Cape Roſſe of S. Iohns Iland	1	52	17	44
In the meridian of Porto Rico	2	52	21	30
At anker on the Weſt ſide of S. Iohn	1	52		
At the Weſt end of S. Iohn de Porto Rico	2	30	17	44
From S. Iohn de P. Rico North northweſt northerly halfe a point	8	0	23	0
Alſo in the ſame courſe	8	0	26	0
Againe in the ſame courſe	8	0	26	20
From Dominica about ſome 140 leagues	0	0	14	0
In the meridian of Barbados fiftie leagues from Martinico	0	0	14	20
At the Iland of Guardelupo	1	0	15	18
At Curſands an Iland of the Weſt Indies	4	0	12	13
At the towne of Rio de Hacha	7	36	11	20
At Cape la vela	7	0	11	50
Thwart Rio de Mayo	15	0	31	0
	15	0	36	0
At Cape Codera	2	30	9	30
At Cape Corientes in Cuba	3	0		
At Cape S. Anthonie in Cuba	13	0	22	0
At Cape Cameron	5	0	25	40
At Cape Florida	3	0	25	30
To the Northward of the Cape of Florida	13	0	28	0

			Variat. West.		Latit. North.	
			De.	Mi.	De.	Mi.
Neere the coast of America			11	0	35	30
From Barmudas Westward 140 leagues			10	0	30	35
From Barmudas Westward 100 leagues			10	3	34	0
Againe from Barmudas 80 or 85 leagues			11	15	34	0
From Cape Raso S. Southwest Southerly			6	30	39	40
			East.			
From Serraleona West by South, and from the shoalds of Madrabombe or S. Anne West and by North 106 leagues			6	10	7	0
In the harbour of Serraleona			1	50	8	30
From the shoare of Serraleona 17 leagues			2	2	3	54
Frō Serraleona 61 leagues West Southerly			2	56	7	58
From the meridian of Sierra-leona Westward	76	leagues	3	29	7	25
	97		3	45	6	0
	153		4	20	4	50
	137		4	12	4	40
	127		3	56	4	30
	142		4	20	4	18
	160		4	58	4	6
	187		4	50	3	0
	187		5	40	1	50
	194		5	45	0	45
					South.	
	195		5	26	0	10
	198		5	30	0	35
	206		6	33	2	0
	210		6	55	2	35
	220		6	45	3	35

From

	Variat. Eaſt.		*Latit. South.*	
	De.	*Mi.*	*De.*	*Mi.*
From C.S. Auguſtine North and by Weſt	7	0	7	16
Frō C.S. Auguſtine North by Eaſt Eaſterly	6	40	1	4
From C.S. Auguſtine North Northeaſt	8	0	4	0
From Cape S. Auguſtine Eaſt northerly 30 leagues	8	10	8	20
From C.S. Auguſtine 100 leagues	11	6	8	30
From C.S. Auguſtine not 120 leagues	5	37	11	30
At the Ile Fernando Laronho neere Braſil	8	30	2	20
Cloſe by the coaſt of Braſil	3	45	7 8 10	0 0 0
A little Weſt from the meridian of Trinidad neere Braſil	11	10	18	30
Among the Ilands of Trinidad & Aſcenſion	12	8	20	35
On the backſide of the Ile of Aſcenſion	12	10	20	30
At the Ile of Aſcenſion	10	0	20	0
In the meridian of Trinidad Eaſterly	14	53	27	0
Between the Iles of Trinidad and Triſtan de Acunha	18 19	0 0		
From the ſhoalds of Braſil Eaſt Southerly about 14 leagues	12	30	19	30
From the ſame ſhoalds Southeaſt about 55 leagues	13	52	20	10
Alſo frō the ſame ſhoalds Southeaſt by Eaſt	13	20	19	37
From the coaſt of Braſil 150 leagues	10	0	18	0
At Cape S. Vincent in Braſil	12	0		
From the coaſt of Braſil 100 or 120 leagues	8 7	30 30	17 18	0 0
From Laronho Southweſt 12 leagues	8	1	4	20

From

	Variat. East.		*Latit. South.*	
	De.	*Mi.*	*De.*	*Mi.*
From Ascension Ile 20 or 30 leagues Eastward at the Cliffe Penedo de S.Pedro	5	30		
Betwixt Ascension Ile and S.Helens	7	30		
At S.Helena	2	48		
	3	46		
	5	37		
	7	30		
From S.Helena a little Westward	9	0		
From S.Helens not 19 leagues	5	40	18	30
From S.Helena Northwest by West 16 leag.	3	45		
From S.Helena Northwest 156 leagues	7	40	10	20
From S.Helena 230 leagues	5	38	8	20
From Ascension Ile Northeast halfe a point Northerly about 12 leagues	6	0		
About the Ilands of Martinvaz	13	0	19	0
Alongst by those Iles	11	15		
From those Ilands northerly 30 leagues	18	30		
From the shoare of Africk Westward some 130 leagues	4	8	27	0
Bearing from thence toward S.Helena	2	48	25	0
From the maine of Africa 160 leagues	2	50	23	0
In the longitude of 28 degrees	15	20	32	0
A little Westward from the meridian of the Iles of Martinvaz	14	58	28	35
Eastward from thence	15	37	28	53
From the former observation 60 leagues	16	8	29	0
From the last observation Eastward 27 leag.	16	52	29	33
Beyond Tristan da cunha 70 or 80 leagues comming from Martinvaz	16	53	33	0

From

	Variat. Eaſt.		*Latit. South.*	
	De.	*Mi.*	*De.*	*Mi.*
From Triſtan da cunha Weſtward	17	52	34	35
	14	0		
At the Iland of Triſtan da cunha	19	0		
From thence Northward	16	8	33	34
Paſt the Iland towards C. Bona Speranza	14	0		
From Triſtan da cunha W.N.W. 368 leag.	14	0	23	25
At Cape Frio	13	0		
Neere Cape Frio	12	0	23	30
From Cape Frio Eaſtward towards Africa	17	0		
	18	0		
From Cape Frio about 125 leag. Eaſtward	11	8		
About 155 leagues from Cape Frio	14	8	25	0
At Port deſire	5	0	47	40
At the Eaſt mouth or entrance into Magellans ſtraits	5	30		
In the ſtraits of Magellan	5	0		
From Cape Bonæ ſpei 900 leagues Weſt by North halfe a point Northerly	15	52	26	50
From Cape Bonæ ſpei almoſt Weſt by N. 180 leagues	8	50	34	0
At the bay of Soldania	0	20	33	55
	1	30	33	20
At Cape Buona Eſperanza	0	15		
	1	30		
About Cape Buona eſperanza	2	0	35	0
From Cape Buona Eſperanza Weſtwards 30 or 40 leagues	5	38		
Betwixt C. Buona eſperanza and S. Helena	3	45		

From

	Variat. East.		*Latit. South.*	
	De.	*Mi.*	*De.*	*Mi.*
From C. Buona Esperanza South	3	45		
From C. Bona Speranza Westward 40 or 50 leagues	3	0		
From C. Buona esperanza due Northwest	5	37	20	0
	West.			
From C. Bonæ spei Sw. by S. 36 leagues	4	10	35	25
From C. Bonæ spei Sw. by S. 28 leagues	3	50	35	30
At Cape das Agulhas neere C. Bonæ spei	0	0		
From thence 80 leagues Eastward	0	0		
At Cape Talhada 40 leagues East frō Cape das Agulhas, being in sight of land lying from vs North by East	3	47	34	20
At C. Corientes beyond C. Bonæ spei	7	30		
	11	0	25	0
From C. Corientes Southwards	8	30	30	30
About the Ilands Primeras towards Mozambique	15	0	18	0
In the Ile Mozambique	12	0	14	45
			North.	
At the Iles of Nicobar	7	36	7	30
	10	0		
From thence till you come to the line going towards the East Indies	11	0		
At the Ile de Almirant neere the line	13	0		
Neere to C. Guarda fui, or Porto Galeacea	8	15	13	15
At P. de estreito or ŷ mouth of the Red sea	5	15	12	15
At Baxos de Cuaquem	1	15	19	15
At Port de Igidid	0	40	22	0

	Variat. West.	*Latit. North.*
	De. Mi.	*De. Mi.*
At Xuarit	0 15 *East.*	
At Sidon in the bottome of the Streights	2 35 *West.*	33 30 *North.*
From the place that is 200 leag. Weſtward from Goa to Cape Comorin	15 0	
At Goa	15 0	15 20
At the Iles Comoro	13 0	
In the Bay of S. Auguſtine in Madagaſcar	15 0	
At C. Romano in Madagaſcar	17 40	26 0
Neere Madagaſcar	8 30	26.0 / 20.0
From C. Romano Southerly	14 4	27 / 30
From C. Romano Weſt Southweſt halfe a point Southerly 110 leagues	14 14	36 34
From C. Romano Southweſt 50 leagues	15 25	28 20
In the height of C. Romano 8 leagues off	16 45	25 50
At the Ile of S. Mary entring the Bay of Antongil	17 0	17 0
In the bottome of the Bay of Antongil by many and exact obſeruations	20 0	
At the Bay of Tanaſſarin	5 30	
At the Weſt ſide of ŷ ſands of Saya de Malha	15 0	11 30
At the Iland Ragapez	23 11	10 0
From the Iland of Gratia Weſt Southweſt 36 leagues	24 11	9 20
At the ſhoalds called Baixos de India	8 30	30 0
At Diego Roiz Iland	21 0	20 0

variation of the Compasse.

	Variat. West.		*Latit. South.*	
	De.	*Mi.*	*De.*	*Mi.*
From Los Romeros Iles South Westerlie 68 leagues	24	15	31	0
From Los Romeros East by South 50 leag.	22	16		
From Los Romeros East 110 leagues	21	20		
At the shoalds of Adu and Candu	19	30	6	0
At the Ile Diego Gratiosa	24	0	9	0
From Diego Gratiosa Westward 20 leagues	22	0	7	30
At Diego Roderigos Iland	20	0		
From Diego Rodericos Iland South, and South and by East	23 24 25		35	0
At Maldiuiæ Ilands	17	0		
			North.	
At Cochin	13	0	9	40
From Cochin till you be past Maldiuiæ Iles South and Southwest till you be vnder 8 and 10 degrees of South latitude	16	52		
At Zeilan	15	30	9	0
At the Ile Pulobatum	4	0	4	
At Achin in Sumatra	8	0		
In the Roade of Achin	6	30		
			South.	
In Priaman on the West side of Sumatra	5	40	0	22
At Bantam in Iaua	5 4	0 30	7	0
At Madura	2	30	6	50
At the Northeast corner of Balij	3	0	8	30
At Banda	4	45	4	50

FINIS.

Faults escaped amend thus.

Pag.	*lin.*	*Faults.*	*Correct.*
3	2	degree,	degree:
	24	ſhew	ſheweth
11	12	lying of	lying, or
	27	ſtowage and	ſtowage, and
	30	vnmeete and	vnmeete, and
	31	ſea as	ſea, as
12	21	geſſe	gheſſe
15	12	o:her	other,
17	4	preciſe	preciſe,
126	28	minute and ſecond	and minute
182	18	R and C	R & C
	22	M, and	M &,
207	5	of all	of the
213	31	tranſuerſaries	tranſuerſarie
214	13	incurre	concurre
219	12	we mentio-	we haue mentio-
233	6	guids	guides
236	32	and a	and an
349	19	Epicicle	Epicycle
359	3	the 6 of	the 26 of
388	13	multiplie	multiplied
429	2	theweſt	the weſt
448	26	ſame	ſunne
450	13	Semediameter	Semidiameter
455	25	both if he	both, if he
455	26	ſo mall	ſo ſmall

In the ſhort Treatiſe of Nauigation.

9	13	a halfe	an halfe
10	10	one and twentieth	eleuenth
10	11	three and twentieth	thirteenth
10	12, 13	two and twentieth	twelfth
20	16	one part	the part
42	26, 28	one ſecond	an half